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ABSTRACT

The purpose of this study was to develop and implement a means of assisting teachers to infuse the teaching of science processes into an existing Unified Science program for grades K through 6. The identification of component science skills for each grade level and subsequent writing of sample activities are described. Field testing of the instructional materials and plans for their implementation are discussed. Numerous appendices include sample instructional materials, and documents concerning their evaluation and testing. (MH)

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ASSISTING TEACHERS TO INFUSE SCIENCE PROCESSES INTO AN EXISTING UNIFIED SCIENCE PROGRAM

by

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Education, Nova University

Baltimore Cluster
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MAXI II Report

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ABSTRACT

The purpose of this practicum was to develop and implement a means of assisting teachers to infuse the teaching of science processes into an existing Unified Science program (K-6). The need was demonstrated in February of 1975 when a county level conference assessed the progress of implementing the new science program. Science process skills were infused into the science program and assisted science teachers. The infusion scheme has been accepted by the Coordinator of Science for implementation in approximately 80 schools (K-6). The flexibility of the process scheme allows for adaptations to other science programs.

INTRODUCTION

In February of 1975 the Nova participant involved in this practicum saw the need for developing a science process scheme for assisting teachers in using a new county science program. Prior to this scheme, the science program did not contain specification for science process skills.

During the academic year 1975-76, the Nova participant gathered necessary background information, conducted production workshops, field tested, and revised materials. The culmination of these efforts resulted in materials to assist teachers by providing a component skill scheme of science processes, points-of-contact in the science program, and suggested process activities. The program has been accepted for implementation on a county-wide basis.

The program has the following characteristics which help contribute to its effectiveness:

1. It contains a component skill scheme. Seven areas of science processes have been identified in the new science program. Each area is specified in terms of component skills involved in teaching the process. The skills are sequenced vertically (K-6) from simple to

complex and horizontally within a grade level.

2. It contains suggested points-of-contact. There is a chart for each of the 113 sub-concepts in the science program showing the relationship between 101 component skills and 583 content objectives. The charts identify initial, not the only, teaching points.

3. It contains sample process activities. Activities are listed for selected points-of-contact in order to illustrate use of the materials and to provide assistance. At least one sample activity is written for each of the 113 sub-concepts.

The practicum materials provide for an organized approach to infuse science processes into the science program. However, the materials allow for individual needs of students and teacher judgement in preparing science units. The program has met with success.

Chapter I of this report discusses the conception of these materials as developed from specific needs.

Chapter II discusses in depth the practicum strategy of this effort. The method and field tested results are presented.

Chapter III is concerned with the results and conclusions of this effort.

Chapter I

ASSESSMENT OF NEEDS

The Problem and Objective

In September 1971 the Anne Arundel County, Maryland, Public School System undertook the process of developing a K-12 science curriculum. Prior to that time the county did not have a program that was consistent and coherent in the specification of learning objectives. The county implemented a task force approach in order to develop the new program. This process provided for the release of a selected group of teachers from classroom responsibilities to spend a year working full time developing the curriculum.

The new K-12 science program is a departure from conventional science teaching in that it incorporates a unified science approach. This approach involves presenting science in terms of major unifying concepts that permeate all science disciplines rather than teaching each discipline (life, earth, physical) as separate areas. The program consist of 180 sub-concepts. Each sub-concept is specified in terms of behavioral objectives. There is a Teachers' Guide (consisting of

learning objectives, activities, and resources) for each sub-concept.

During the developmental stage of the program, the area of scientific knowledge was specified in terms of learning objectives and sequenced (K-12). Appendix A on page 45 illustrates the kind of objectives written for a typical science sub-concept in the program. However, the year devoted to this curriculum effort did not provide enough time to develop the area of science process learning. The task force product contained a definition for each of the identified science processes. (Appendix B on page 46)

The problem that surfaced in the attempt to implement the curriculum was that classroom teachers did not have a complete model that specified objectives in the area of science processes. This void has created a situation in which classroom teachers have not known how to deal with this area of the program. Therefore, they have given little or no attention to incorporate processes with the teaching of scientific knowledge.

During January and February of 1975, the Curriculum Development Department held a series of meetings dealing with the status of implementing the Unified Science Program. The meetings were attended by Coordinators of Instruction and science resource personnel from each of the four geographical districts in the county. One of the outcomes identified in these sessions was the need to have the area of science process learning specified in terms compatible with the program.

Following these meetings the Anne Arundel Nova participant met with key decision makers in the Curriculum Development Department and in the Department of Instruction. It was recognized that if teachers were truly to function effectively in using the program, they would need specification in this area. The importance of developing this practicum has been identified by Mrs. Eva Pumphrey (Director of Curriculum), Mr. Harold Bloom (Coordinator of Science), and Dr. Harry Hendrickson (Director, Area I). (Appendix C on page 47)

Chapter II

PRACTICUM STRATEGY

Research Effort

The research activities were begun in the early stages of the Maxi II project in June, 1975, and continued through December, 1975. These efforts were intended to locate possible sources of information which could be used to provide background data on science process programs, to provide models for teaching science processes in a unified science program, to identify materials for use in the production workshops, and to offer assistance in the formative and summative evaluation of the Maxi II project.

Research data were obtained from three basic sources, and the method of collection is described below:

1. use of relevant periodicals, books, and other publications;
2. input from personnel sources within the local system; and
3. input from personnel sources giving of their time in a consultant manner.

Current Periodicals, Books, and Other Publications

The Mechanized Information Service (MIC) offered by the Center for Unified Science at Ohio State University was used to obtain a computer-assisted search of the Educational Resources Information Center (ERIC) collection and the files of the Current Index to Journals in Education (CIJE). The Thesaurus of ERIC Descriptors provided the search parameters to help identify the publications which were related to the Maxi II project. These descriptors included: process, education, curriculum development, and evaluation.

After completing this process, the area of evaluating science process learning and projects was identified as needing further research. A meeting was held with the Coordinator of Research , Mr. Thomas Rhoades, in the county and the Director of Research at the Maryland State Department of Education, Dr. James Fisher. Also, a computer-assisted search of the Educational Resources Information Center (ERIC) collection and the files of the Current Index to Journals in Education (CIJE) was conducted using a recently completed facility in the county. The Thesaurus

of ERIC Descriptors included: curriculum development, elementary school science, evaluation, curriculum evaluation tests, evaluation methods, program evaluation, skill development, discovery processes, and science tests.

The printouts obtained from these two sources listed relevant publications from the ERIC and CIJE files. A screening of the printouts was conducted to identify titles which were directly related to the project. Abstracts of related articles or copies of articles were made available through the services of the Anne Arundel County Board of Education Media Center and the Research Department of the Maryland State Department of Education. These titles served as a basic working bibliography during the development, evaluation, and conclusion phases of the Maxi II project.

Personnel Input

In order to identify specific needs, the Nova participant met with the Director of Curriculum and the Coordinator of Science. These meetings dealt with the specification of outcomes for the practicum. In order for the project to provide a county level product,

support was needed from the Assistant Superintendent of Instructional Programs and the Area Director from each of the four geographical districts.

Planning sessions with the Coordinator of Science were conducted in order to identify those needs to be requested from county officals. The most important need was for a committment to provide substitute time for releasing classroom teachers to work in the two production workshops. Appendix D on page 49 presents a summary of needed human resources. Following these planning sessions, the Coordinator of Science presented the project to the Assistant Superintendent of Instructional Programs. Approval was obtained to provide substitute time. (Appendix E on page 51)

Once the project design had been organized, meetings and conferences were held with area personnel to explore the feasibility of such a project and to enlist their support and approval. Separate meetings were conducted in each of the four geographical districts with the Director and Assistant Director to request assistance in identifying and releasing classroom teachers for the workshops. The proposal was well received and a committment given to

support the project. The following officals were instrumental in providing resources needed to give the project county level exposure and involvement:

Miss Ruth Dudderar	Assistant Superintendent of Instructional Programs
Mrs. Eva Pumphrey	Director of Curriculum
Dr. Harry Hendrickson	Director, Area I
Mr. Arthur Bruni	Assistant Director
Mrs. Winifred Fowler	Director, Area II
Mr. Oliver Rephann	Assistant Director
Mr. Everett Pettigrew	Director, Area III
Mr. Edward Mitchell	Assistant Director
Mr. James Dunagan	Director, Area IV
Mr. Richard Milbourne	Assistant Director

The next phase involved identification of personnel to participate in the production workshops and in the field testing of materials. With the assistance of Area Directors and other area personnel, classroom teachers were selected on the basis of experience in teaching the science program. One classroom teacher was identified from each of the four districts. A K-12 science resource person was identified from three districts on the basis of interest in the project, expertise, and availability. From the list of recommended workshop members, the following were selected:

Classroom Teachers

Mrs. Sharon Bright	Hillsmere Elementary
Miss. Jean Everhart	Woodside Elementary
Mrs. Kitty Handschuh	Sunset Elementary
Mr. Mel Montgomery	Old Mill Middle

Resource Personnel

Mr. John Mills	Area III Office
Mrs. Diane Prather	Area II Office
Mr. Neal Fertitta	Area I Office

Coordinator of Science

Mr. Harold Bloom	Central Office

As one of the area based resource persons responsible for instructional support services in science, K-12; it was appropriate that Neal Fertitta (Nova participant) serve as chairperson and member in a workshop task group.

An elementary school was identified to field test materials developed by this committee. Since Area I was the base office for the Nova participant, it was appropriate to select a school in that area. Permission was given for this aspect of the project by the Area Director. (Appendix F on page 53) After identifying

the school, a presentation was made to the principal and K-6 staff members teaching Unified Science. The principal and staff were very enthusastic about the project and gave their committment to the field testing phase. The support from the following persons at Woodside Elementary School was an invaluable assest:

Mrs. June Jackson	Principal
Mrs. Shirley Howell	Kindergarden
Mrs. Marie Pietsch	Kindergarden
Mrs. Lois Stevens	Grade 1
Mrs Kay Harkness	Grade 2
Miss. Pat Tate	Grade 2
Mr. Charles Bledsoe	Grade 3
Mrs. Marge Cogar	Grade 4
Mr. Vern Fleury	Grade 5
Miss. Jean Everhart	Grade 6

Support in scheduling work sessions at the school was provided by Mr. Hal Roth, Coordinator of Instruction from the Area I Office. (Appendix G on page 54)

Participant Resources

During the planning phase of the project, other individuals provided assistance in identifying model science process projects, in identifying process oriented activities for students, to critique materials developed in the workshops, and to help during the field testing phase. The Coordinator of Staff Development, Mrs. Eileen Oickle, provided assistance in obtaining workshop credit through the Maryland State Department of Education for an inservice course. Dr. Homer Schamp, professor at the University of Maryland, offered to work with the Nova participant in identifying process projects and in teaching the inservice course. The Area I based resource person in the Gifted-Talented program, Mr. Thomas Subock, critiqued the component skills developed for science processes and worked at Woodside Elementary.

Needs Assessment

A series of meetings were held by the Nova participant with the Director of Curriculum, Coordinator of Science, and the representative from the University of Maryland beginning with "brainstorming" activities

which led to direct plans of action. In these sessions participants discussed possible approaches for providing assistance to teachers in teaching science processes.

It was determined that for teachers to incorporate science processes in their teaching, materials would have to be developed that provided assistance and did not require long hours of extra preparation or extensive course study. The decision was made to develop two kinds of materials. During the first production workshop, participants would develop a scheme consisting of a sequence of COMPONENT SKILLS to be taught for science processes listed in the county program. A component skill was defined as a statement indicating a specific skill to be taught for a given science process. The program would consist of several component skills written for each process. The component skills would be sequenced vertically from K-6 for each process to indicate a progression from simple skills to more complex skills. Also, the component skills would be sequenced horizontally so that at each grade level the skills for all processes could be viewed as a whole. Therefore, a series of charts would be developed to show

vertical and horizontal relationships for the component skills.

A second production workshop would be held to prepare sample process activities. In the elementary level of the science program there are 113 sub-concepts. During the workshop, participants would develop one sample activity for each sub-concept. The activities would illustrate a possible approach for teaching the process area but not dictate the only approach.

A third need as teachers implement new materials or approaches was identified as inservice training and support services. Dr. Homer Schamp and the Nova participant would develop a plan for providing assistance in this area. The plan would involve two phases working concurrently as teachers implemented the science process materials. Dr. Schamp would offer an inservice course at Woodside Elementary dealing with the teaching of science processes. Concurrent with this effort, the Nova participant would work with teachers during the regular school day to identify appropriate process activities; conduct demonstration lessons; and diagnose student needs.

Keeping Needs Assessment Current

It was recognized that the needs of teachers implementing the program during the field test phase would require a constant assessment of their professional needs and assistance in using program materials. A close working relationship would be needed between the University of Maryland instructor, the Gifted-Talented program resource person, the Nova participant, and the field test site teachers. Those component skills found to be inappropriate or of little use would be eliminated. Those needing revision or further development would be dealt with. Areas of professional development needed by classroom teachers would be provided. Flexibility in planning for training and implementation of the materials was emphasized as of paramount importance in keeping assessment of needs current.

Practicum Objectives

The conceptualized solution to the need for filling the void in the Unified Science program by developing science process materials compatible with the program formed the basis for the following practicum objectives :

1. A county level committee will develop materials for teaching science processes in an existing unified science program.

    1.1 The committee will breakdown the definition for science processes listed in the Unified Science program to give specification for each in terms of component skills.

    1.2 The component skills will be compatible with the existing science program.

    1.3 Sample activities will be provided at each grade level that illustrate the infusion of science processes into the science program.

2. The science process materials will be field tested on a K-6 basis.

    2.1 Participating teachers will teach at least one unit using the component skills.

    2.2 At least 30% of the students will show a 20% gain in ability to use science processes as measured by a pretest-posttest instrument.

3. A plan will be developed and implemented to provide teachers with inservice preparation and support services.

4. The materials will be accepted by the Coordinator of Science in Anne Arundel County for implementation in other schools.

Procedures for Developing Component Skills

The county committee for the first workshop was composed of three classroom teachers, two K-12 science resource people, and the Coordinator of Science. Released time for classroom teachers was obtained from the Assistant Superintendent of Instructional Programs. Resources necessary to develop the scheme of component skills was provided by the Coordinator of Science and the Nova participant.

Prior to the workshop, the practicum designer developed aids which would enable committee members to proceed with their writing tasks in an efficient manner. The following items were prepared specifically for this workshop:

1. Workshop Agenda - consists of a sequence of activities in order to illustrate the direction and time patterns in the four-day workshop. Consideration was given in its design to provide maximum production value. (Appendix H on page 55)

2. Workshop Goals - provided a list of the five areas to be completed in the workshop. (Appendix I on page 56)

3. Component Skill Correlation Form - a visual chart designed to assist the team members in coding component skills to educational objectives in the science program for each of the 113 sub-concepts from K-6. (Appendix J on page 57)

4. Evaluation Forms - enabled the Nova participant to gather subjective and anonymous evaluations of the workshop by the team members. (Appendix K on page 58)

The committee members were also provided with appropriately organized and coded copies of the Unified Science Taxonomies of Objectives and Unified Science Teachers' Guides.

Production Workshop # 1

The first workshop was held (October 22, 23, 24, 30, 1975) using the facilities of the Area I Office. In line with the agenda, an orientation session was held to familiarize all team members with the purposes and objectives of the project. An overview was provided of the structure of the Unified Science program, the need to develop a component skill scheme for science processes, and materials illustrating other process projects.

After the orientation session was completed, the committee was divided into three teams - one to develop component skills (K-2), one for grades 3 and 4, and one for grades 5 and 6. Each team consisted of two members - a classroom teacher and science resource person or the Coordinator of Science.

The first assignment was for each team to examine the science content specified for the assigned level in terms of the kinds of science process teaching implied by the content educational objectives. Each team used the list of science processes for the science program and identified those that could be specified in terms of component skills for that level.

After this initial session, the total group met to identify those science processes to be specified by component skills for the total program. From the list of 14 processes in the Taxonomy, three were omitted. They were either included in other county programs or involved mental processes that could not be defined for purposes of this committee (measuring and using numbers -- covered by the new math program, communicating -- covered by the new reading goals program, and

formulating models -- not measurable in terms useful for component skills). A breakdown of skills was completed for measuring and using numbers by using objectives from the new math program. This was done to assist teachers in seeing where needed math skills were taught in the math program. The remaining processes were organized into seven categories and given the following process code numbers:

Process Number 1 : Observing
Process Number 2 : Classifying
Process Number 3 : Inferring
Process Number 4 : Formulating Hypotheses and Predicting
Process Number 5 : Experimenting and Controlling Variables
Process Number 6 : Interpreting Data
Process Number 7 : Space/Time Relationships

During the workshop 101 component skills were written for the seven categories of processes. Each of the seven processes consisted of approximately 14 component skills. For each grade level, a teacher would be concerned with approximately two component skills for each process or a total of 14 component skills. This was not seen as an unreasonable or difficult number for teachers to handle.

During the workshop, all of the 113 sub-concepts in the K-6 part of the science program were examined in terms of component skills. The science program contained 583 content educational objectives (K-6). Each educational objective was examined for the skill(s) that could best be correlated with teaching the content. A Component Skill Correlation Form was used for this purpose. (Appendix J on page 57)

As part of the formative evaluation effort, the committee used the following forms to provide a record of the degree of coverage in coding component skills to content educational objectives:

1. Educational Objectives - Correlated to Component Skills - provides a visual of the educational objectives coded to the seven process areas for each of the 583 objectives. (Appendix L on page 59)

2. Educational Objectives Not Correlated to Component Skills - provides a visual of the educational objectives not correlated to component skills for each of the 113 sub-concepts. (Appendix M on page 60)

Committee members used the analysis of the work provided by these forms to re-examine the

points-of-contact they did not make in the initial effort.

Team writing sessions were scheduled with total group review and discussion sessions interspersed at appropriate intervals. Review and discussion periods helped to clarify directions, perfect procedures, and assess progress. Such sessions also enabled teams to share ideas and materials. The procedure helped to preserve the quality of the process, and to maintain morale and cohesiveness in the group. During the evening following each workshop day, all materials produced were edited and duplicated so that task group members could examine them in detail during the first session of the next day.

The first production workshop was highly successful in completing the identified goals. Of the 583 content educational objectives, only 10 were not correlated to component skills. A closer examination of these objectives demonstrated that they were not oriented to process teaching. The total correlation of component skills to content objectives was 98.3 %. Therefore, this phase of the project demonstrated a high degree of compatibility

between the component skill schema and the Unified Science program. A visual demonstrating the degree of correlation achieved by the committee titled Analysis of Correlation Between E.O.s and Component Skills can be found in Appendix N on page 61.

At the completion of the workshop, participants expressed feelings of mental and physical fatigue. But, they also expressed feelings of satisfaction for the job accomplished. This is illustrated by their comments recorded on an anonymous evaluation form. (Appendix O on page 64)

Procedures for Developing Sample Process Activities

Members from the first committee were involved in the second production workshop. Due to the magnitude of the task, committee membership was increased by two classroom teachers. As previously stated, released time was provided by the Assistant Superintendent of Instructional Programs. Other resources were provided by the Coordinator of Science and the Nova participant.

Prior to the workshop, the following aids were prepared:

1. Workshop Agenda - consists of a sequence of activities in order to illustrate the direction and time patterns for the three-day workshop. (Appendix P on page 66)

2. Suggested Activity Forms - a sheet for recording sample process activities for each of the 113 sub-concepts. (Appendix Q on page 67)

3. Component Skill Booklet - a preliminary booklet of the product from Workshop # 1 was prepared so that members would have available a good copy of the skills and correlation charts.

4. Evaluation Forms - enabled the Nova participant to gather subjective and anonymous evaluations of the workshop by the team members. (Appendix R on page 68)

Committee members were also provided with copies of the Unified Science Taxonomies of Objectives and Unified Science Teachers' Guides.

Production Workshop # 2

The workshop was held (November 19-21, 1975 using the facilities of the Area I Office. The initial session dealt with a review of the product from the first workshop and a description of the kind of process activities

to be prepared during this workshop. The goal for the effort was to write one sample process activity for each of the 113 sub-concepts.

Following the initial session, the committee was divided into three teams - one to develop activities (K-2), one for grades 3 and 4, and one for grades 5 and 6. The teams for grades 3-4 and 5-6 consisted of three members in order to handle the greater number of sub - concepts.

Each team was directed not to force unnatural and artifical activities with sub-concepts. The activities were to illustrate ones that could be prepared by teachers without the continued resource of materials provided by a county committee or requiring expensive science equipment. Team members used the component skill correlation forms to identify points-of-contact between skills and content objectives. After identifying a point-of-contact, team members wrote a sample activity. Each team was directed to first check existing Teacher Guides for locating sample activities. In many cases activities were identified that could be used as stated or with slight modification. In other cases, team

members prepared activities by drawing upon their expertise.

Writing sessions were scheduled with total group review and discussion periods at the end of each day or as needed. This procedure helped to preserve the quality of the product by sharing experiences.

The second production workshop was highly successful in completing the task. One sample activity was prepared for each of the 113 sub-concepts. In several cases two or more activities were felt to be appropriate for a given sub-concept. The product of this workshop provided 100 % coverage. This result illustrates the ease with which component skills could be infused into the Unified Science program.

At the completion of the workshop, committee members gave their comments on an anonymous evaluation form. Their feelings of satisfaction for the job accomplished and its anticipated value to other teachers can be appreciated by reading the compilation of comments in Appendix S on page 69.

Resource Inputs in Both Workshops

The following instructional staff members visited with task groups during the production workshop and encouraged and assisted them in their work:

Dr. Harry Hendrickson	Director, Area I
Mr. Arthur Bruni	Assistant Director
Mrs. Eva Pumphrey	Director of Curriculum
Mrs. Eileen Oickle	Coordinator of Staff Development
Mr. Harold Roth	Coordinator of Instruction, Area I

In many cases they were able to spend part of a day working in a task group.

The committee was also assisted by Dr. Schamp, University of Maryland, and Mr. Subock of the Gifted - Talented program in Area I. They reviewed the scheme of component skills and the sample activities. Their comments were used as part of the formative evaluation process. Revisions were made where needed.

The Process of Field Testing

1. Use of quality checks

In line with the objective to develop instructional materials for assisting teachers to infuse process teaching into the existing science program, the products from both workshops were subjected to a series of three quality checks. As areas needing revision were identified, changes were made in the materials.

The first quality check involved a critique of each teams product during the workshop. This process was performed using the expertise of other committee members meeting in a total group session. At this time, the team explained the component skills written for their level or discussed the activities written for skills. Materials were critiqued on the basis of: are all skills for the process specified; are the skills appropriately sequenced vertically (K-6); is skill development within a grade level well defined; are the suggested activities good illustrations for teaching skills; etc.? Following this session, the materials were revised. These meetings occurred at planned intervals and at other times.

The second quality check involved a critique of the component skill scheme and the suggested activities by Dr. Homer Schamp and Mr. Thomas Subock. They used the same kind of criteria as previously stated. Also, the purpose for this quality check was to obtain a second point-of-view in order to determine if the materials were coherent, consistent, and complete. Following a meeting with them, the materials were revised by the Nova participant or committee members.

The third quality check involved field testing materials at a previously identified elementary school. The purposes for this process were to determine if the materials could be used by others; to continue assessing the materials in areas described above for the second quality check; and to determine if students would show growth in their use of process skills.

2. Testing procedure

The selection of the school for field testing involved seeking the approval and assistance of the following persons: Dr. Hendrickson, Director of Area I, Mrs. Jackson, Principal of Woodside, and the staff.

The criteria used in selecting the school included: the interest of the principal and faculty in using these materials; the support service available to the school by the University of Maryland; and present association of the practicum participant with the school.

After the participating school was identified and approval received from the faculty, several sessions were conducted to familarize them with the materials and to make arrangements for field testing. A total of nine teachers was involved in this phase of the project. Teachers were asked to select one class of students from their grade level for purposes of pretesting and posttesting. The pretest would be used to indicate a students readiness for process activities. The posttest would be given to determine any change in student growth in using process skills. Teachers were directed to select groups heterogeneous in ability levels and representative of students in the grade. A total of 150 students were selected: 10 from kindergarden, 23 from grade one, 26 from grade two, 20 from grade three, 24 from grade four, 26 from grade five, and 21 from grade six.

The Nova participant used a previously identified test instrument obtained from the University of Texas at Austin through the services of the Center for Unified Science at Ohio State University. The test was in two parts with one test for levels K-3 and a second test for levels 4-6. (Appendix T on page 71) Students were pretested during the week of December 12, 1975. The tests were scored and results prepared for teacher use during the first week in January, 1976.

Prior to the January, 1976 implementation date, a schedule of support services was specified with the cooperation of the principal. (Appendix U on page 98) The field testing phase would be from January 5, 1976 through April 2, 1976. During this phase, the Nova participant was assisted by Mr. Subock, a specialist in process learning. Both persons worked as a team to provide the following services to teachers: interpretation of the component skill scheme; identification of instructional materials; obtaining and/or constructing additional materials; presenting demonstration lessons; working with children in small groups or individually; and assessing the use of the skill scheme and activities.

The first session with each teacher in January dealt with discussing the pretest results and selecting initial component skills to be taught. This session was followed by one in which activities were selected for teaching the skills. Each teacher was given materials that summarized the important points to be stressed in teaching the new unit. (Appendix V on page 99) The Nova participant worked with the teacher during class time and outside the class schedule on dates listed in the schedule and at other times.

During this phase a record was kept of classroom observations to indicate possible changes in student use of processes; teacher use of process teaching skills; and as an assessment device to identify needs. The observation form developed by Lawson, Devito and Nordland was used for this purpose.[1] (Appendix W on page 100)

Concurrent with the support service provided by the Area I Office was the assistance of Dr. Schamp from the University of Maryland. The Nova participant worked with

[1]Anton Lawson, Alfred Devito, Floyd Nordland, "How's Your I.Q. (Inquiry Quotient)? : An Instrument to Measure Inquiry Teaching in the Science Classroom," School Science and Mathematics, Kalamazoo, Michigan, School Science and Mathematics Association, February, 1976, pp. 139-151.

him during the summer and the months preceeding field testing in order to develop an inservice course. The course was approved by the county Coordinator of Staff Development. Teachers would be given the option of taking the course for two graduate college credits from the university or two inservice credits from the Maryland State Department of Education. Appendix X on page 101 describes the course. Seven teachers attended the inservice program that was conducted each Thursday evening for three hours from January 22, 1976 through April 1, 1976. (Appendix Y on page 105)

The objectives of the course were: to formulate an operational knowledge of the meaning associated with specific science processes; to operationalize the teaching of science processes by developing appropriate activities; and to develop skill and technique in teaching science processes. Participants were involved in a variety of activities that included discussions, demonstrations, and construction of projects. Each participant developed process activities for the sub-concept being taught. These activities were shared with the total group. The Nova participant attended

the sessions in order to assist teachers to apply the inservice experience in their classroom situation.

Editing and Printing

The end product of the committee effort was a set of two guides to be used with other Unified Science program materials. The first booklet titled "Component Skills" contains the skill scheme and suggested points-of-contact between component skills and content objectives in the science program. The second booklet titled "Sample Activities" contains at least one sample activity for each of the 113 sub-concepts.

The format and preparation of these booklets was done by the Nova participant. The secretary to the Coordinator of Science typed all the materials. The Coordinator of Science made arrangements for the production of the booklets through the Board of Education Printing Office.

Chapter III

RESULTS AND CONCLUSIONS

Results

The practicum objectives were met as the following summary of results shows:

1. Practicum Objective #1

A COUNTY LEVEL COMMITTEE WILL DEVELOP MATERIALS FOR TEACHING SCIENCE PROCESSES IN AN EXISTING UNIFIED SCIENCE PROGRAM.

A county level committee was formed with the support of the Assistant Superintendent of Instructional Programs, Director of Curriculum, the four district Area Directors, and the Coordinator of Science. Two workshops were conducted involving classroom teachers and science resource people from the districts.

A. Practicum Objective #1.1

THE COMMITTEE WILL BREAKDOWN THE DEFINITION FOR SCIENCE PROCESSES LISTED IN THE UNIFIED SCIENCE PROGRAM TO GIVE SPECIFICATION FOR EACH IN TERMS OF COMPONENT SKILLS.

In the first workshop participants identified seven areas of process skill development from the list in the science program. Component skills were written for each of the seven processes. A total of 101 skills was written with the average science process defined in terms of 14 skills. The following excerpt from the guide titled

"Supplementary Guide - COMPONENT SKILLS" will clarify how the teacher uses this section of the program:

This section consists of seven major areas of science process development. Each process has been specified in terms of component skills.

In using this section each teacher will identify those skills that best meet the needs of his/her students. For your assistance, each component skill has been identified by code to a specific Proficiency Level (program name for sub-concepts) in order to indicate a possible teaching point. However, you are not limited to this suggested teaching point and are encouraged to use the nature of the science program in your school and the needs of your students as indicators of the process component skills to be taught during a given school year.

B. Practicum Objective #1.2

THE COMPONENT SKILLS WILL BE COMPATIBLE WITH THE EXISTING UNIFIED SCIENCE PROGRAM.

The committee sequenced the skills vertically from basic to complex for grades K-6 and horizontally within a grade to form a process block. A component skill correlation form was completed for each of the 113 sub-concepts. Component skills were correlated to 98.3 % of the 583 content objectives in the science program. This high level of correlation was achieved without forcing points-of-contact. (Appendix L, M, N, on pages 59, 60, 61 respectively)

The following excerpt from the guide will clarify how the teacher uses this section:

The K-6 part of the Unified Science program consist of 12 Proficiency Levels (sub-concepts).

In this section are contained seven charts for each of the 12 Proficiency Levels. Each chart deals with one science process. Each chart shows points-of-contact between the component skill(s) for each process and content educational objectives in a Proficiency Level Objective. An asterick (*) indicates those E.O.s for which activities may be more easily developed in your initial teaching effort.

It is not intended that each teacher teach to all these contact points. This would probably be an impossible task. The purpose of the charts is to indicate those points of contact that lend themselves best to developing process activities for the listed component skills. The final identification of specific educational objectives to be taught with special emphasis on process component skills remains a decision of each teacher.

In conclusion, this committee emphasizes the need for each school to develop a K-6 plan that will provide for and assure a specified level of infusion of teaching science processes with existing science content. The county coordinator of science and area science resource personnel can be of assistance and should be called upon.

C. Practicum Objective #1.3

SAMPLE ACTIVITIES WILL BE PROVIDED AT EACH GRADE LEVEL THAT ILLUSTRATE THE INFUSION OF SCIENCE PROCESSES INTO THE SCIENCE PROGRAM.

The K-6 science program contains 113 sub-concepts. In the second workshop participants wrote at least one sample activity for each sub-concept. Also, in several

situations two or more activities were written for a given sub-concept. The product of the workshop provided 100 % coverage. This high level of infusing process activities into the science program was achieved without forcing points-of-contact. In fact, in many cases participants were able to locate existing activities in Teacher Guides that met the requirements for the skills.

A second booklet containing these activities was published titled "Supplementary Guide - SAMPLE ACTIVITIES." The following excerpt from the guide illustrates how a teacher uses the activities:

> Prior to using this guide, it is suggested that each teacher identify those skills that best meet the needs of his/her students. In order to complete this task, refer to the charts dealing with the Proficiency Level (sub-concept) in question. These charts are located in the first booklet.
>
> The intent and purpose of the activities contained in this guide are to provide a suggested activity for teaching a specific point-of-contact between the Educational Objectives and the Component Skills. You may want to use a different activity for the same point-of-contact. You may want to teach a process activity for a different point- of-contact. This decision is part of your role as teacher in identifying student needs and selecting appropriate learning activities. The sources for selecting the activities for this booklet are - (a) activities contained in existing Teacher guides as stated or with suggested modification and (b) activities of an original nature or taken from other guides.

2. Practicum Objective # 2

THE SCIENCE PROCESS MATERIALS WILL BE FIELD TESTED ON A K-6 BASIS.

A field test situation was established at Woodside Elementary involving nine teachers and 150 students. Students were pretested before using the materials and posttested at the completion of the field test phase. Observations were made of classroom situations.

A. Practicum Objective #2.1

PARTICIPATING TEACHERS WILL TEACH AT LEAST ONE UNIT USING THE COMPONENT SKILLS.

Each teacher taught at least one science unit (sub-concept) designed to incorporate the skills. In several cases more than one unit was taught during the three month test period. Appendix V on page 99 illustrates a typical planning sheet.

Mr. Thomas Subock and the Nova participant shared responsibility for making classroom observations. One teacher from each grade level was observed five times during the three months or an average of once every other week. Reference can be made to the Classroom Observation Form in Appendix W on page 100. The results

of observations were discussed and decisions made for supplying support services to teachers.

On the observation form, criteria are organized into the following four major categories: the lesson, student behavior, teacher behavior, and questioning techniques. The criteria can be used to evaluate one lesson or a series of lessons. Most scales are scored on a 0 to 4 basis. The scales for criteria 8, 9 and 10, however vary somewhat in that they involve student inquiry behavior and reflect a 0 percent to 100 percent range of class time. The evaluator makes a judgement as to the appropriateness of the amount of time spent by students in various activities. In using the form, not all items may apply to a lesson. In this case, the question does not serve as a point of evaluation and should be disregarded. Since some questions will not be answered, a total score from all lessons would not serve as consistent measures of comparison. For this reason the following formula is used to enable standard lesson scores to be obtained from the total criteria scores which will serve as consistent comparisons.

$$\text{Total Criteria Score} \times \frac{25}{\text{Number of Questions Answered}} = \text{Standard Lesson Score}$$

The average observation score given prior to field testing was 72. The average score after three months was 85. This gain in ability to teach process skills was related in some cases to a teachers initiative for self improvement in using the process materials and in other cases to the combined effort of the inservice program and area office support services. (Appendix Z on page 106)

The reactions of the field test participants were very positive. They felt that these aids would save them the time that they would have spent in defining the points-of-contact and preparing a component skill scheme. They felt that the suggested activities would help them to understand more precisely the point-of-contact and yet leave them the opportunity and option to substitute their own activities. At the completion of the field test phase, the teachers were asked to complete a reaction form. (Appendix AA on page 107)

B. Practicum Objective #2.2

AT LEAST 30% OF THE STUDENTS WILL SHOW A 20% GAIN IN ABILITY TO USE SCIENCE PROCESSES AS MEASURED BY A PRETEST-POSTTEST INSTRUMENT.

The actual gain was greater than the target percentage. Of the 150 students tested, 54.7 % showed a 20% gain from pretest to posttest. Further analysis showed that: 66.7% of the students gained 15%; 76% gained by 10%; and 86 % showed a 5% gain.

These gains were felt to be important ones by the Gifted-Talented resource person, the Coordinator of Science, and the Nova participant. In fact, it was felt that to achieve a 10% gain by 50% of the students would have been an important gain in three months.

The mean scores for the tests showed an increase at all grade levels. The kindergarden level showed the least gain because students tested high on both pretest and posttest. The following chart summarizes the results:

Table 1

Pretest-Posttest Means

Grade	Pretest	Posttest
K	25.6	27.4
1	11.2	27.5
2	19.5	26.2
3	17.2	25.1
4	7.9	12.3
5	11.4	14.1
6	11.8	14.4

Charts containing the results summarized above are referenced to Appendix BB, CC, DD on pages 109, 113, 115.

3. Practicum Objective #3

A PLAN WILL BE DEVELOPED AND IMPLEMENTED TO PROVIDE TEACHERS WITH INSERVICE PREPARATION AND SUPPORT SERVICES.

A two phase plan in which activities would take place concurrently was designed by the Nova participant with assistance from the University of Maryland and the Area I Office personnel.

The first phase involved an inservice course conducted at Woodside Elementary through the services of the Teaching Center at the University of Maryland. Classes met once each week for three hours during the

three month field test period. The course titled Science Process Teaching in the Unified Science Program was designed to assist teachers using the component skills. Upon completion of the course teachers received either two graduate credits or two inservice credits depending on the request made at registration. The format of this course also provided a pattern the county could duplicate in school system sponsored programs.

The second phase involved support services from the Area I Office which included the Gifted-Talented program resource person and the Nova participant. As previously described, a schedule of activity at the school was specified. The above personnel provided services on the basis of two days per week during January and February and one day per week in March. When services were needed at other times, arrangements were made by the Nova participant.

In order to coordinate the activity involved in both phases, the Nova participant served as a liaison person between the school staff and the University staff.

4. Practicum Objective #4

THE MATERIALS WILL BE ACCEPTED BY THE COORDINATOR OF SCIENCE IN ANNE ARUNDEL COUNTY FOR IMPLEMENTATION IN OTHER SCHOOLS.

The Coordinator of Science was actively involved in all phases of the practicum. He was very pleased with the outcome of the Maxi II project as shown in his letter in Appendix EE on page 116.

The program meets with his approval and as stated in the letter will be disseminated and implemented at the earliest possible date.

Conclusions

The component skill process scheme with accompanying sample process activities seems to be an adequate and effective product for infusing process teaching into the existing Unified Science program.

The component skill scheme has applications for any science program. Another school or school system could use these materials to provide an effective way of teaching science process learning and for staff development.

APPENDIX A

Taxonomy of Objectives

Proficiency Level No. 1

Proficiency Level Statement: Man has identified specific relationships that exist between living and non-living things in our biosphere.

Major Unifying Concept No. I, V

Proficiency Level Objective Statement: No. 1

The student will determine four properties of living and non-living things through observation and contact on the basis of the following list:

a. color
b. size
c. shape
d. texture
e. hardness
f. weight
g. taste
h. odor
i. occupies space

Educational Objective Statements:

1. The student will group assorted objects according to color, size, shape, texture and hardness by observing, touching and grasping.

2. The student, after engaging in the activity such as filling a container with pebbles, will conclude that solids occupy space.

3. The student will, by using a measuring device, compare the relative weight of solid objects, using solids of the same size but different weight, and solids of different sizes and different weights.

4. The student will classify solid foods as either bitter, sweet, sour or salty.

5. The student will distinguish between objects that have pleasant and unpleasant odors, and those that are odorless.

6. The student will list the characteristics of some animals in terms of the following categories:

a. body coverings
b. weight
c. shape
d. occupies space
e. color
f. size

7. The student will identify the characteristics of plants in terms of the following categories:

a. weight
b. shape
c. occupies space
d. texture of stems and leaves
e. color
f. size

APPENDIX B

PROCESSES OF INQUIRY

Observing	Describing characteristics of objects or events by using one or more of the senses.
Classifying	Grouping an array of objects or events according to their characteristics.
Space/Time Relationship	Describing objects or events in terms of their presence in a setting and their change with the times.
Using Numbers	Using math skills in order to describe conditions, characteristics, experiences or events.
Communicating	Using symbols to transfer information.
Measuring	Quantifying objects, conditions, characteristics or events through the use of instrumentation and standards.
Predicting	To project on the basis of observations, experiences or scientific reason.
Inferring	Using previously acquired knowledge to explain an event.
Formulating Hypothesis	A tentative explanation for a phenomenon that may be empirically tested.
Controlling Variables	Limiting the number of changeable factors in an experimental situation.
Experimenting	An operation carried out under controlled conditions in order to discover an unknown effect or law, to test or establish a hypothesis, or to illustrate an unknown law.
Defining Operationally	Defining in terms consistent with the individuals own experiences with more than one operational definition being possible in a particular situation.
Formulating Models	A description or analogy that helps one visualize something that cannot be directly perceived.
Interpreting Data	Using factual material (such as graphs, maps, or data) as the basis for making inferences, predictions, or hypothesis.

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

2644 Riva Road
Annapolis, Maryland 21401
Telephone: 301-224-0113

April 25, 1975

Mr. Neil V. Fertitta
866 Shore Acres Road
Arnold, Maryland 21012

Dear Mr. Fertitta:

Thank you for coming to the office to discuss with me the proposal for your practicum. I feel that your planned project is a worthy one and is much needed in the county.

The curriculum work group that developed the new science program did an outstanding job of organizing content. Unfortunately, they had too little time to devote to processes of science.

Your work in sequencing and infusing science processes into the program will be of great value.

I heartedly recommend that you proceed with your practicum as described.

Yours truly,

Eva M. Pumphrey

(Mrs.) Eva M. Pumphrey
Director of Curriculum

111

BOARD OF EDUCATION: G. George Asaki, president, F. Carroll Smith, vice president, Dr. Delores C. Hunt, Mrs. Maureen Lamb, Col. Raymond C. Smith, Charles G. Truffer, Mrs. S. Edwin Zimmerman, J. Jeffrey Robinson (student member)

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

2644 Riva Road
Annapolis, Maryland 21401
Telephone: 301-224-0113

April 21, 1975

Dr. Kaylin
Nova University
Fort Lauderdale, Florida

Dear Dr. Kaylin:

The Anne Arundel County Unified Science Program was initially developed on a conceptual (product of science) basis even though this approach was a compromise of our program model. The concession was to the process aspect of our model — primarily due to the realization that our writing team would be unable to work with the process/product grid with the manpower and time frame available.

Infusion of the processes into the Unified Science sequence is a needed next step in making the program as effective as we desired. The Nova participant will certainly have the support of this office in the proposed practicum effort to accomplish that which we have not had opportunity to do on an official basis.

Should the product prove successful we would mutually consider approval for use in approximately 100 of our county schools.

Sincerely,

Harold W. Bloom

Harold W. Bloom
Science Program Coordinator
Anne Arundel County Public Schools

4-23-75

kw

BOARD OF EDUCATION: G. George Asaki, president, F. Carroll Smith, vice president, Dr. Dolores C. Hunt, Mrs. Maureen Lamb, Col. Raymond C. Smith, Charles G. Truffer, Mrs. S. Edwin Zimmerman, J. Jeffrey Robinson (student member)

APPENDIX D

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

memo

TO: Mr. Harold Bloom, Science Program Coordinator FROM: Neal Fertitta, Sci. Res.

DATE: May 7, 1975

SUBJECT: First Draft of Needs for the Science Process Project

COPY TO: Practicum Observers-
Mrs. Pumphrey
Mrs. Oickle
Mrs. Jackson

The following is a summary of our brain storming session to identify the needs (human resources & substitute time) for the development of the Science Processes Project.
Next meeting for reconsidering these items- May 14, 1975.

I. Needs for Elementary Level Program Development

1. Phase 1 - Compile list of names of possible participants.
Contact science resource personnel in areas.

2. Phase 2 - Production Workshop 1 - Develop Process Skill Breakdown

A 3 day workshop involving 3 classroom teachers and 2 science resource members.

Hold 1 follow-up day session with same personnel.

This phase requires utilization of 12 substitute days.

3. Phase 3 - Production Workshop 2 - Identify Process Activities

K-3 and 4-6 would consitute the two working groups.

Each group to include 2 classroom teachers and 1 science resource person. A 4 day workshop.

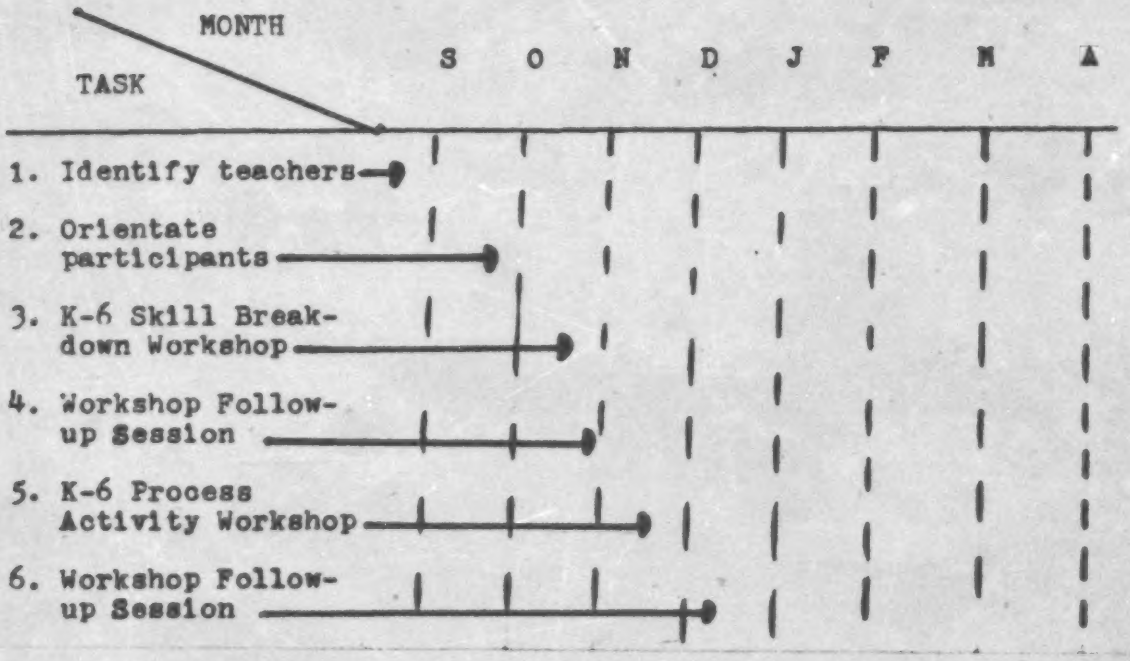
Hold 1 follow-up day session with same personnel.

This phase requires utilization of 16 substitute days.

4. Total number of substitute days needed to develop the K-6 levels in terms of a Process Skill Breakdown and Development of Process Activities is 28.

May 7, 1975 meeting
Mr. Harold Bloom
Mr. Neal Fertitta

III. Approximate Time Line



ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

memo

TO: Maxi II Practicum Observers:
Mrs. Pumphrey, Mrs. Oickle, Mrs. Jackson
SUBJECT: Status Report- Unified Science Process Project

FROM: Neal Fertitta
DATE: September 30, 1975
COPY TO: Mr. Bloom

- Work on the Maxi II practicum has continued through the summer. The following is a status report for phase 1 - dealing with developing the specification of component skills for science processes, K-6.

  - Mr. Bloom and I prepared a plan for developing project materials at the central office level. He presented the plan to Mr. Hall, Asso. Super. Instr., Miss. Dudderar, Assist. Super. Instr. Prog., and Mrs. Pumphrey, Dir. of Curr. They have approved the project and given support by allocating 28 substitute time days for the two workshops that constitute phase one of the project.

    The project now becomes an official Board of Education project. Therefore, in order to facilitate communication within the county, the practicum officially titled "Assisting Teachers to Infuse Science Processes into an Existing Unified Science Program" will be called the Unified Science Process Project.

  - A meeting with Science Resource Personnel from Areas II and III was held on 9/6/75 by Mr. Bloom and myself to explain the project and to request names of teachers for the workshops. They have submitted names.

  - Approval has been granted by Area Directors in the four geographical areas for using teachers and resource personnel in the project. Mr. Bloom has confirmed the arrangements for the workshops with area personnel.

  - The schedule of workshops is:

    Production Workshop 1 - Development of Process Skill Breakdown

    October 22, 23 and 24 (all day)
    October 30 (follow-up day)

    Production Workshop 2 - Identifying Process Activities

    November 19, 20 and 21 (all day)
    December 17 (follow-up day)

more -

- Phase 2 of the project dealing with implementing the workshop product is on schedule.

  - Dr. Harry Hendrickson, Dir. Area I, has approved the implementation of project materials in the area.

  - Implementation will be at Woodside Elementary. Mrs. Jackson has approved the project and has given much support for the implementation phase at her school.

  - A meeting was held at Woodside on 6/16/75 to explain the project and to seek approval from teachers of the Unified Science program from K-6. Approval of the teachers was given to this county project.

  - Mr. Roth, Coordinator of Instr., for the school has also approved the project.

  - A meeting will be held on 10/6/75 at Woodside to briefly give the staff a status report and to make needed arrangements. Mr. Bloom and I will summarize progress made to date.

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

AREA OFFICE I
1st Avenue & A Street
Glen Burnie, Maryland 21061
Telephone: 301-760-4200

April 24, 1975

Mr. Neal Fertitta
Science Resource
Area I Office
Glen Burnie, Md. 21061

Dear Mr. Fertitta:

This letter is in reference to our recent conversation dealing with your Maxi II Practicum Proposal for Nova University entitled Assisting Teachers to Infuse Science Processes into an Existing Unified Science Program.

After reviewing the proposal, I feel that this practicum will fill the present void in the new county science program by making available to teachers a useful mechanism for incorporating the processes of science listed in the program into their program in the twenty-six schools in Area I on a K-12 basis, you are in a good position to provide this needed service to our teachers.

You have my approval for conducting this project in the area's schools and my support in the testing phase of project materials. The details of this process and the identification of participating schools can be specified as the project materials are developed and ready for testing.

Sincerely yours,

Harry C. Hendrickson

Harry C. Hendrickson
Area Director

ee

BOARD OF EDUCATION: G. George Asaki, president, F. Carroll Smith, vice president, Dr. Dolores C. Hunt, Mrs. Maureen Lamb, Col. Raymond C. Smith, Charles G. Truffer, Mrs. S. Edwin Zimmerman, J. Jeffrey Robinson (student member)

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

memo

TO: Dr. Harry Hendrickson, Director Area I

SUBJECT: Status of the Science Process Project

FROM: Neal Fertitta
DATE: June 3, 1975
COPY TO: Mr. Bruni
Mr. Bloom
Practicum Observers:
Mrs. Pumphrey
Mrs. Oickle
Mrs. Jackson

Status of work at the county level

- Mr. Bloom and I have developed a plan by which the process project can be completed next year. Present plans include teacher involved production-type workshops for next year. The final course of action will depend on the budget.

- The goal is to complete the process scheme K-9 and to index activities in Teacher Guides for the process related skills.

- Mr. Bloom has indicated that when successfully completed the project materials will be provided for all elementary and junior high schools in the county.

- Teachers using the materials will not have to do extra planning. In fact, the materials will make planning for teaching science activities easier and more consistent from grade to grade (P.L. to P.L.).

Status of work at Woodside Elementary

- In conjunction with your approval to test and implement a plan to assist teachers in using the processes identified in the science program, I met with Mrs Jackson and team leaders from primary and intermediate levels. They were very interested in participating in the program. I believe the school is an ideal place for this project.

  They requested preliminary information so that work could begin in September. I have prepared materials over the holiday and will provide them for their use until a final product is available from the county level.

- Mr. Roth has approved the project for use at Woodside.

Anne Arundel County Public Schools
Department of Sciences — Annapolis, Maryland

UNIFIED SCIENCE WORKSHOP

Process Project

Conference Room, Area I Office
October 22, 23, 24

Day I

9:00-9:30	Overview: The need for and direction of the workshop -- Harold W. Bloom
9:30-9:45	The State of Science Process Teaching in Unified Science Approach--Neal Fertitta
9:45-10:00	BREAK
10:00-10:30	A Model for Developing a Science Process Scheme -- - Neal Fertitta
10:30-11:30	Subgroup Work Session (K-2; 3, 4; 5, 6)
11:30-12:30	LUNCH
12:30-12:45	Questions-Answers on Procedures
12:45-3:00	Continuation of subgroup work.
3:00-3:30	Progress Assessment, Total Group.

Day II

9:00-9:30	Correlation of subgroup activity.
9:30-11:30	Subgroup work session.
11:30-12:30	LUNCH
12:30-3:30	Continuation of subgroup work.

Day III

9:00-9:30	Correlating Process Learning K-6
9:30-11:30	Subgroup and/or total group work session.
11:30-12:30	LUNCH
12:30-3:00	Total group work session.
3:00-3:30	Summary and evaluation of workshop.

HWB/kw

APPENDIX I

UNIFIED SCIENCE PROCESS PROJECT

Workshop Goals

Production Workshop- 1 Development of Component Skills

1. Identification of processes to be brokendown into component skills.
   a. How many of the original 14?
   b. How will others be handled in the program?
2. Break down science processes into component skills.
   Check sequence vertically and horizontally for-
   - continuity
   - completeness
   - level of difficulty
3. Identify teaching - learning points for component skills in the science program.
   Complete Correlation Chart for each process.
4. Develop format for organizing component skills,
   ex: a scope and sequence chart.....?
5. Check work for completeness of materials for typing.

APPENDIX J

Unified Science Process Project

COMPONENT SKILL CORRELATION FORM

Process _____ P.L. - ____

P.L.O.s Level	EDUCATIONAL OBJECTIVES Coded for Component Skills (CS)			
	C.S. ☐	C.S. ☐	C.S. ☐	C.S. ☐
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

APPENDIX K

UNIFIED SCIENCE PROCESS PROJECT

Evaluation

Production Workshop - 1 October 22 - 24, 1975

I. Process

Overall what is your general opinion of the workshop procedures?

Do you feel the concept of the small-group team was a good one?

Were the needed materials and resources provided and organized?

Did you feel enough time was allotted for the tasks?

If it is decided to replicate this procedure for the secondary levels, what changes would you recommend?

II. Product

What is your estimate of the overall quality of the workshop products?

Do you feel the component skill breakdown of processes will be helpful to science teachers?

Can you state something about the value of the products of this workshop to teachers and students?

III. General

Did you enjoy the workshop?

Were the facilities adequate?

Any other comments or suggestions?

APPENDIX L

Unified Science Process Project

P.L. ____

EDUCATIONAL OBJECTIVES . . . CORRELATED TO COMPONENT SKILLS

P.L.O. Levels	Classifying	Observing	Inferring	Form. Hypo. & Predicting	Experimenting & Contro. Var.	Interpret Data	Space/Time Rela.
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

APPENDIX M

Unified Science Process Project

THE EDUCATIONAL OBJECTIVES NOT CORRELATED TO COMPONENT SKILLS

P.L.	P.L.O.	E.O.s(-)
I	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
II	1	
	2	
	3	
	4	
	5	
III	1	
	2	
	3	
	4	
IV	1	
	2	
	3	
	4	
	5	
	6	
	7	
V	1	
	2	
	3	
	4	
	5	
	6	
	7	
VI	1	
	2	
	3	
	4	
	5	
VI	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
VII	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
VIII	1	
	2	
	3	
	4	
	5	
	6	
IX	1	
	2	
	3	
	4	
	5	
IX	6	
	7	
	8	
	9	
	10	
	11	
	12	
X	1	
	2	
	3	
	4	
	5	
	6	
	7	
XI	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
XII	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	

APPENDIX N

Unified Science Process Project

ANALYSIS OF CORRELATION BETWEEN E.O.s AND COMPONENT SKILLS

P.L. I	P.L.O.	1	2	3	4	5	6	7	8	9	10		
	E.O. (+)	7	5	7	3	3	3	4	6	4	3	T= 45	
	E.O. (-)											T= 0	100 % Corr.
P.L. II	P.L.O.	1	2	3	4	5							
	E.O. (+)	6	4	2	4	4						T= 20	
	E.O. (-)											T= 0	100 % Corr.
P.L. III	P.L.O.	1	2	3	4								
	E.O. (+)	7	12	7	4							T= 30	
	E.O. (-)											T= 0	100 % Corr.
P.L. IV	P.L.O.	1	2	3	4	5	6	7					
	E.O. (+)	4	5	3	5	5	4	3				T= 29	
	E.O. (-)											T= 0	100 % Corr.
P.L. V	P.L.O.	1	2	3	4	5	6	7					
	E.O. (+)	8	5	4	4	5	4	4				T= 34	
	E.O. (-)											T= 0	100 % Corr.
P.L. VI	P.L.O.	1	2	3	4	5	6	7	8	9	10		
	E.O. (+)	6	5	7	3	4	3	3	7	7	5		
	E.O. (-)		1	1					1				
	P.L.O.	11	12	13	14	15							
	E.O. (+)	3	4	5	7	3						T= 72	
	E.O. (-)											T= 3	95.8% Corr.

P.L. VII	P.L.O.	1	2	3	4	5	6	7	8	9	10			
	E.O. (+)	2	5	4	4	7	4	3	5	9	4			
	E.O (-)													
	P.L.O.	11	12	13	14	15	16	17						
	E.O. (+)	4	6	6	5	6	3	5				T= 82		
	E.O. (-)				1							T= 1	98.8 %	Corr.
P.L. VIII	P.L.O.	1	2	3	4	5	6							
	E.O. (+)	11	5	6	4	4	4					T= 34		
	E.O. (-)			1								T= 1	97.1 %	Corr.
P.L. IX	P.L.O.	1	2	3	4	5	6	7	8	9				
	E.O. (+)	3	4	6	4	4	7	3	4	3				
	E.O. (-)													
	P.L.O.	10	11	12										
	E.O. (+)	5	2	4								T= 49		
	E.O. (-)											T= 0	100 %	Corr.
P.L. X	P.L.O.	1	2	3	4	5	6	7						
	E.O. (+)	3	4	4	7	5	10	3				T= 36		
	E.O. (-)											T= 0	100 %	Corr.
P.L. XI	P.L.O.	1	2	3	4	5	6	7	8	9				
	E.O. (+)	4	7	7	8	6	4	5	6	8				
	E.O. (-)	1			1									
	P.L.O.	10	11	12										
	E.O. (+)	3	5	5								T= 68		
	E.O. (-)			1								T= 3	95.6 %	Corr.

F.L. XII	P.L.O.	1	2	3	4	5	6	7	8	9
	E.O. (+)	5	3	12	6	7	9	3	11	5
	E.O. (-)				1					1

	P.L.O.	10	11
	E.O. (+)	6	8
	E.O. (-)		

T= 75

T= 2 97.3 % Corr.

SUMMARY TOTAL

From K-6 there are 583 E.O.s

The number of component skills are 121

TOTAL % infusion points is - 98.3

APPENDIX O

UNIFIED SCIENCE PROCESS PROJECT

Evaluation

Production Workshop - 1

October 22 - 24, 1975
October 30, 1975

I. Process

- Overall what is your general opinion of the workshop procedures?

  ...The procedures were well organized to get the task done... Professional yet informal... Very profitable... Very good - structured but informal enough to feel comfortable with...

- Do you feel the concept of the small-group team was a good one?

  ... Yes...Yes, if larger would not have been affective... Yes... Yes...

- Did you feel enough time was allotted for the tasks?

  ... Yes... Yes... Yes... Yes...

- If it is decided to replicate this procedure for the secondary levels, what changes would you recommend?

  ... Less opening day introduction to task... None really... Basically the same... No change...

II. Product

- What is your estimate of the overall quality of the workshop products?

  ... Very good! ...Excellent... Working with process development is like opening a new frontier. I think the quality is good for this stage of development and will continue to improve with work... Very good - much needed...

- Do you feel the component skill breakdown of processes will be helpful to science teachers?

  ... Yes... Definitely should if teachers can be emphasized to use it correctly... Yes... Definitely...

--- MORE ------

- Can you state something about the value of the products of this workshop to teachers and students?

  ... It will be most helpful to teachers and students operating in a "hands on" program as Unified Science should be.
  ... When used as intended, teachers should be able to pinpoint process development. They should also have available activities that will assist in this development. Students will be getting process development in a systematized manner rather than incidental.
  ...Students are at last going to be encouraged to use their thinking processes.
  ...Until now, the processes in science were not being taught in an organized manner. It will be easier for the teacher to follow a skill sequence and therefore, do a better job teaching processes.

III. General

- Did you enjoy the workshop?

  ... Yes... Yes, the people were easy to work with, no pressure yet we worked hard... Yes... Certainly.

- Were the facilities adequate?

  ... Yes... Yes... Yes... Yes.

- Any other comments or suggestions?

  ... none... none... Let's get together again soon!... Its also rewarding working on projects like these for you get so many other views. It also gives you an opportunity to interact in a way not usually available..

Anne Arundel County Public Schools
Department of Sciences — Annapolis, Maryland

UNIFIED SCIENCE WORKSHOP

Process Project

Conference Room, Area I Office
November 19, 20, 21

Day I

9:00-9:15	Infusing science processes into the Unified Science Program. -Harold W. Bloom
9:15-9:45	Developing appropriate science process activities-Workshop procedure -Neal Fertitta
9:45-10:00	BREAK
10:00-11:30	Work Session I: Developing activities
11:30-12:30	LUNCH
12:30-12:45	Questions-answers on procedure
12:45-3:00	Work Session II: Continuation of sub-group work
3:00-3:30	Progress assessment, total group

Day II

9:00-11:30	Work Session III: Continuation of sub-group work
11:30-12:30	LUNCH
12:30-3:30	Work Session IV: Continuation of sub-group work

Day III

9:00-11:30	Work Session V: Correlating sub-group activities
11:30-12:30	LUNCH
12:30-3:00	Work Session VI: Total group work session
3:00-3:30	Summary and evaluation of workshop

Harold W. Bloom
Coordinator of Science

kw

11-7-75

UNIFIED SCIENCE PROCESS SCHEME

P.L. _____	P.L.O. _____

PROCESS(ES):

COMPONENT SKILL(S):

SUGGESTED ACTIVITY FOR E.O. _____

SOURCE: Teacher Guide - Activity Number _____ page _____

Other - _____

APPENDIX R

UNIFIED SCIENCE PROCESS PROJECT

Evaluation

Production Workshop - 2 November 19 - 21, 1975

I. Process

- Overall what is your general opinion of the workshop procedures?

- Do you feel the concept of the small group team was a good one?

- Were the needed materials and resources provided and organized?

- Did you feel enough time was allotted for the tasks?

- If it is decided to replicate this procedure for the secondary levels, what changes would you recommend?

II. Product

- What is your estimate of the overall quality of the workshop products?

Do you feel the sample activities will be helpful to elementary level teachers of science?

Can you state something about the value of the products of this workshop to teachers?

to students?

III. General

Did you enjoy the workshop?

Were the facilities adequate?

Any other comments or suggestions are appreciated?

THANK YOU

APPENDIX S

UNIFIED SCIENCE PROCESS PROJECT

Evaluation

Production Workshop - 2 November 19 - 21, 1975

I. Process

- Overall what is your general opinion of the workshop procedures?

  ... The workshop in my opinion was very good. I got a chance to get better acquainted with the materials.
  ... Excellent! Good direction. Clear task assignments.
  ...Efficient... Well organized... Very good - relaxing and productive... Professional and productive.

- Do you feel the concept of the small-group team was a good one?

  ... I feel the concept of small group work was a good one. It really saved tiem and provided for interaction between group members in completing assigned task.
  ... Yes... Yes... Very productive... Yes... Yes.

- Were the needed materials and resources provided and organized?

  ...The materials and resources were provided and well organized.
  ... Yes, very well organized... Yes... Yes... Yes... Yes.

- Did you feel enough time was allotted for the tasks?

  ... Yes... Yes... Yes... Yes... Yes... Yes.

- If it is decided to replicate this procedure for the secondary levels, what changes would you recommend?

  ... none... Just as is at present... Will need more teams for secondary... none... none... none.

II. Product

- What is your estimate of the overall quality of the workshop products?

  ... I think the overall workshop products were good. This will provide for a variety of acitvities for the various levels of pupils.... Very good... The product seems to be thorough and well done... Good... Fantastic!... Very good.

- - - - MORE - - -

- Do you feel the sample activities will be helpful to elementary level teachers of science?

  ... Yes... Definitely... Yes... Yes... Yes... Yes.

- Can you state something about the value of the products of this workshop to teachers?

  ...It will definitely be helpful to teachers in providing more direction in process teaching and a better understanding. ... These activities are probably the best ones at each unit level. Teachers will see the value of using these suggested activities for they really bring out process development in a meaningful way... I think it will make it easier for teachers to organize and include the teaching of processes.... ... More hands on acitivites... Good activities and techniques .... More interesting activities than some in the unit booklets.

value to students?

...Better techniques by teachers makes a more enjoyable program for kids... Makes available more hands on activities and ones that are process oriented... The processes will be better taught, in a sequential order, therefore, the students will probably master them, and be able to apply them in other situations... These are almost entirely hands on, experimental type activities. Student involvement in these activities will increase interest and promote retention of concepts.... It will give students more of an opportunity to use their minds in order to answer questions rather than teachers just presenting the material.... more profitable.

III. General

- Did you enjoy the workshop?

  ... Yes... Very much... Yes... Yes... Yes... Definitely.

- Were facilities adequate?

  ... Yes... Great... Yes... Yes... Very adequate... Yes.

- Any other comments or suggestions are appreciated.

  ...none... none... none... none... Thank for asking me to participate... none.

Unified Science Process Scheme
Anne Arundel County, Maryland

PRIMARY SCIENCE TEST

Pretest - Posttest Instructions

This test has been developed by -

The Research and Development Center for Teacher Education

The University of Texas at Austin

Dr. David P. Butts, Professor

The following pages contain directions for administering the test.

Neal Pertitta
Area I Office

Materials Needed

Question	Materials
1	Set of 4 balls (golf, ping pong, tennis, and rubber)
5	An equal arm balance
19	2 blocks (wood or plastic, any color)

Instructions

This test is to be administered by you giving the instructions for each question. You make the following responses and then students record their answer.

BEGIN

Show the children a set of 4 balls including a golf ball, a ping pong ball, a rubber ball, and a tennis ball.

1. In box 1, draw a picture of one way in which these are all the same.

2. I have named these balls

"A" (for golf ball)

"B" (for tennis ball)

"C" (for rubber ball)

"D" (for ping pong ball)

Suppose you were to put them into two groups. In box 2, write the letter of the balls you would put in group 1 and group 2.

3. In box 3, draw a picture of your reason for putting the balls in your group 1.

4. In box 4, draw a picture of your reason for putting the balls in group 2.

5. Here is a balance. Put an "X" on the picture that will show what happens if I put the golf ball here (child's right) and the ping pong ball here (child's left).

6. In box 6, you will see pictures of these 4 balls.

   Put a 1 on the one that you think has the most push on the balance.

   Put a 2 on the one that you think has the next to most push on the balance.

   Put a 3 on the one that you think has the next to least push on the balance.

   Put a 4 on the one that you think has the least push on the balance.

7. Suppose you watch me as I put the golf ball and the tennis ball on the balance. Do the results agree with what you thought in question 6? Place a circle around the word yes or no.

8. In box 8, you will see many figures. Put an "X" on a set of those that you think are alike.

9. Now draw a picture of the way you think all the figures in your group "X" are alike.

10. Look back at box 8. Put an "A" on another group of figures that you think are the same.

    In box 10, draw a picture of the way you think the figures in your group A are alike.

11. In box 11, you will find the same figures you saw in box 8. Suppose you could only put them into 2 groups. Write 1 or 2 on each figure to show which group you would put it in.

12. In box 12, you will see a group of figures that are the same in some way. Write or draw a picture of how they are the same.

13. In box 13 you will see a picture of these four objects. Put an "X" on the picture of something that is solid.

14. In box 13, put an "A" on something that is liquid.

15 & 16. In box 13, put a 1 on the container that you think will hold the most.

Now put a 2 on the container you think will hold next to most.

Now put a 3 on the container you think will hold next to least.

Then put a 4 on the container that will hold the least.

17 & 18. In box 17, you will see pictures of three thermometers.

Put a 1 on the thermometer that shows the warmest day.

Put a 2 on the thermometer that shows the next to warmest day.

Put a 3 on the thermometer that shows the coolest day.

19 - 22. Here are two blocks. In box 19, mark the senses you could use to learn more about these two blocks.

23. In box 23, circle what day of the week today is.

24. In box 24, circle what day of the week tomorrow willbe.

25. In box 25, circle what day of the week yesterday was.

26. In box 26. draw an arrow to show how I <u>am moving</u> this cube (move the cube from the table <u>up</u>).

27. In box 27, put an "X" on the left hand of the man.

28. In box 28, put an "X" on the right hand of the man.

SCORING KEY

Process	Item	Acceptable Response
Obs.	1	Child's drawing indicates they all have the shape of a circle - or are balls.
Class.	2	If each of the four letters is in one of the two boxes and if each letter is written only <u>once</u> - accept.
Class.	3 & 4	If you can distinguish between the "reason" drawn for #3 and #4, accept both responses.
Meas.	5	Child should have marked the right hand drawing.
Meas.	6	Golf Ball = 1 Rubber Ball = 2 Tennis Ball = 3 Ping Pong Ball = 4 This order may vary depending on the balls actually used.
Meas.	7	Check the child's order in #6. If he had a smaller numeral for the golf ball and a larger numeral for the tennis ball, he should have checked YES.
Obs/S/T	8	Accept if the child has put an "X" on the 2 squares or the 2 triangles or the 2 circles or the 2 rectangles or the ellipse.
S/T	9	Accept if the child has drawn the shape that matches the figures he marked with an "X" .
S/T	10	Score similar to #8 and #9 .
S/T	11	One group would be all those figures with points or straight lines, squares, triangles, and rectangles. The other group would be those with curved edges or circles and ellipse.
S/T	12	The child should draw a shape like a triangle.

Obs.	13	Accept if the child puts an "X" on any of the containers.
Obs.	14	Accept if the child puts an "A" on container "d".
Meas.	15 & 16	1 on "d" 2 on "b" 3 on "c" 4 on "a"
Obs.	17 & 18	The child should put 1 on thermometer "c" 2 ' ' "a" 3 ' ' "b"
Obs.	19 - 22	Accept if the child marks three of these four - eyes, ears, hand, and nose.
S/T	23	Accept if the child is accurate.
S/T	24	Accept if the child is accurate.
S/T	25	Accept if the child is accurate.
S/T	26	Accept if the child makes an arrow pointing up.
S/T	27	Accept if the child marks an "X" on the left side of the man.
S/T	28	Accept if the child marks an "X" on the right side of the man.

TOTAL SCORE

Subscores

Observing	1 + 13 + 14 + 17 + 18 + 19 + 20 + 21 + 22	9 points
Using Space Time Relations	8 + 9 + 10 + 11 + 12 + 23 + 24 + 25 + 26 + 27 + 28	11 points
Classifying	2 + 3 + 4	3 points
Measuring	5 + 6 + 7 + 15 + 16	5 points

My Name Is _____

My Grade Is _____

Science Is Fun
Primary Science

1.

2. Group 1

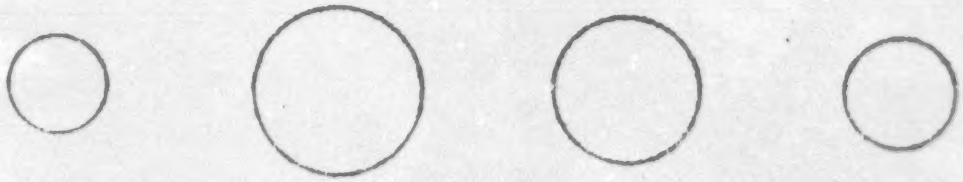
Group 2

3.

4.

5.

6.

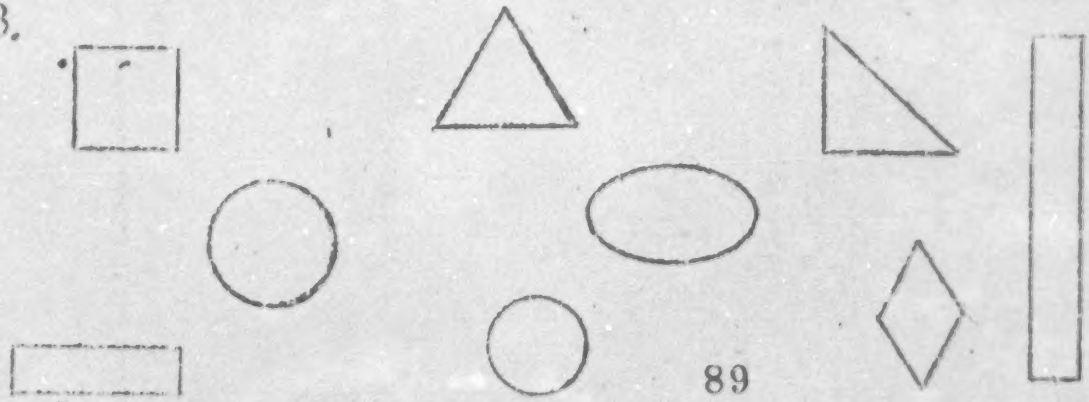


Ping Pong Ball | Tennis Ball | Rubber Ball | Golf Ball

7.

YES NO

8.

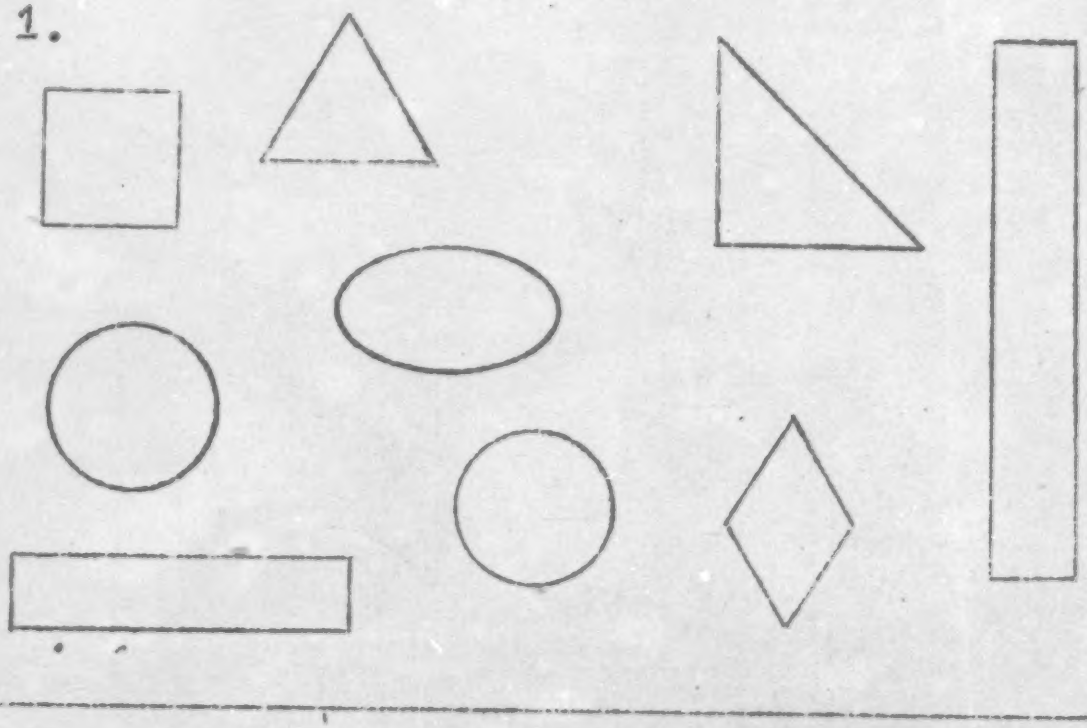


89

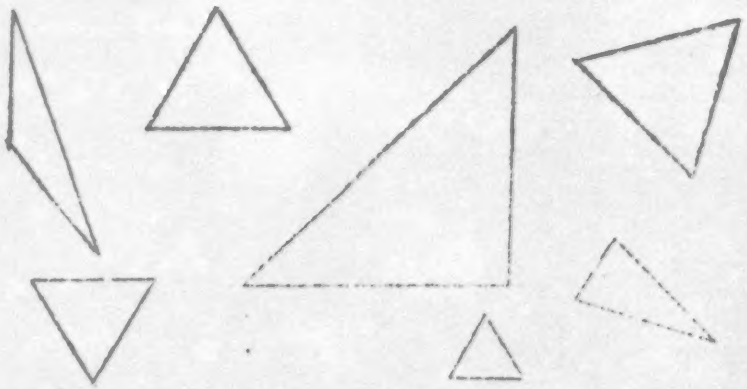
9.

10.

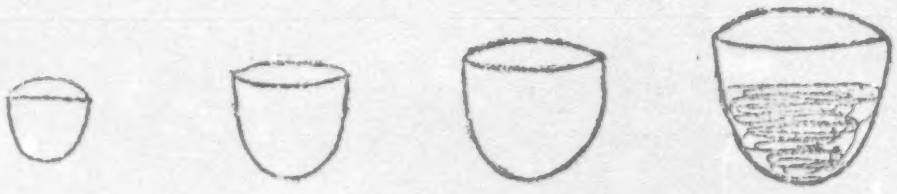
11.



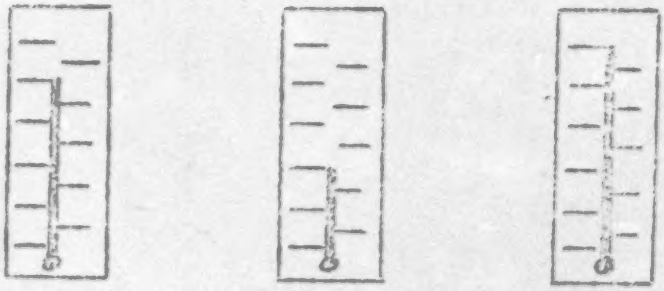
12.



13.

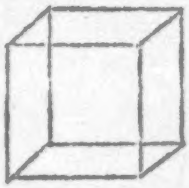


17.



19.

23.	24.	25.
Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday	Monday Tuesday Wednesday Thursday Friday Saturday Sunday

26.	27.	28.
		

Unified Science Process Schome
Anne Arundel County, Maryland

INTERMEDIATE SCIENCE TEST

Pretest - Posttest Instructions

This test has been developed by -

The Research and Development Center
for Teacher Education

The University of Texas at Austin

Dr. David P. Butts, Professor

The following pages contain directions for administering the test.

Neal Fertitta
Area I Office

Instructions

The test is a multiple choice test.

Information needed for student instructions is contained on the first page of the test.

SCORING KEY

ITEM	PROCESS	ANSWER
1	pred.	B
2	pred.	C
3	inter. data	C
4	S/T	A
5	infer.	C
6	contro. var.	D
7	S/T	C
8	infer.	C
9	S/T	E
10	meas.	A
11	S/T	B
12	obser.	B
13	meas.	B
14	meas.	C
15	S/T	D
16	meas.	E
17	inter. data	B
18	infer.	B
19	inter. data	E
20	infer.	E
21	infer.	C
22	pred.	C
23	pred.	B

INTERMEDIATE SCIENCE TEST

DIRECTIONS:

This is a test of some of the ideas and skills you have been developing in your study of science. You should take the test in the same way you would work on any interesting assignment. Here are a few suggestions that will help you earn your best score.

1. Make sure that you understand the directions for taking the test before you begin working on it. You may ask questions about any part of the directions you do not understand.

2. You will make your best score by answering every question because your score is the number of correct answers you mark. Work carefully but do not spend too much time at any one question. If a question seems to puzzle you, make a careful guess and don't waste time.

3. If you complete the test before the time period is finished, you may go back and spend additional time on those questions that puzzled you.

4. Each of the questions is followed by five suggested answers. You are to decide which one of these answers you wish to choose. You must then mark all of your answers on the separate answer sheet that has been given you. Please do not mark on the test booklet in any way. If you have any questions on how to use the answer sheet, please raise your hand.

1. In an experiment with a new type of freezer, George found that a container of four units took 20 minutes to freeze, and a container of eight units took 60 minutes to freeze. How long would it take a container of six units to freeze?

   A. 20 minutes.

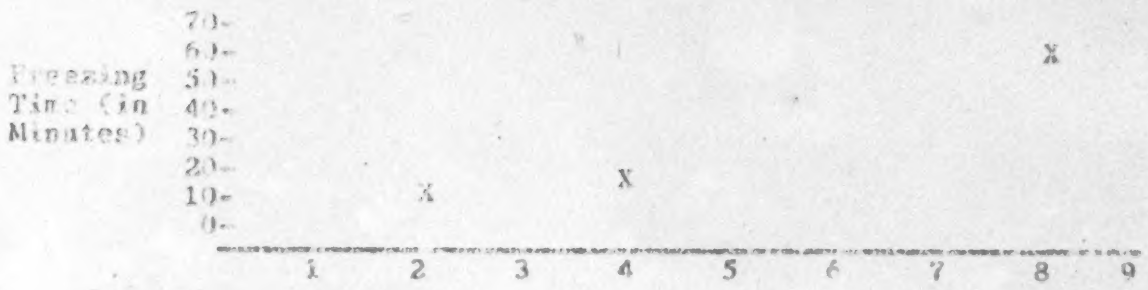
   B. Between 30 and 50 minutes.

   C. More than 60 minutes.

   D. Less than 20 minutes.

   E. About 70 minutes.

2. George had been experimenting with his new freezer. He used many different sized containers to see how long it would take water to freeze. He found these results:



What do you think he found for a one unit container?

   A. 20 minutes freezing time

   B. 15 minutes freezing time

   C. 10 minutes freezing time

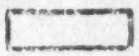
   D. 5 minutes freezing time

   E. 25 minutes freezing time

3. Kim kept a record of how many people went in three different doors at the fun house at the fair. In an hour's time she counted eleven going in at the three foot door, nineteen going in at the four foot door, twenty-seven going in at the five foot door, and twenty-nine going in at the six foot door. Suppose Kim wanted to build a new fun house. From her data, what is the relationship that she could use?

   A. Tall people bend over to get in.
   B. There are very few tall people at the fair.
   C. The taller the door, the more people will come in.
   D. The shorter the door, the more people will come in.
   E. Some people don't like fun houses.

4. When Shirley cut an orange in half, what shape did she see on the cut surface?

   A.
   B. 
   C.
   D.
   E.

5. In his experiment Ken planted six seeds. Four seeds germinated and grew. He planted 12 more seeds. How many plants should he expect from his second set of 12 seeds?

A. 12
B. 10
C. 8
D. 6
E. 4

6. In his experiment, Ken identified several variables that might help him to explain the results. Which variable should he <u>not</u> investigate?

A. The kind of seeds.
B. The age of the seeds.
C. The amount of sunshine.
D. The day of the week he planted the seeds.
E. The amount of water he gave the seeds.

7. A boy rolls a ball from the starting point on a race track toward the goal line. What information would you need to find out the speed of the ball?

A. The size of the ball.

B. The distance from the starting point to the goal line.

C. The distance the ball rolled and the time it took to roll that distance.

D. The time the ball was rolling.

E. The distance the ball rolled.

8. As Janet came into the kitchen, she saw her mother working. She saw a large cookie sheet with brown cookies. How could Janet test the inference that her mother had just baked the cookies?

A. Call her best friend.

B. Tell her mother how hungry she was.

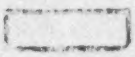
C. Sniff the air and touch the cookies to see if they were warm.

D. Check the cupboard and see if there was flour there.

E. Ask her mother if she had been to the store that afternoon.

9. When Charlie cut a cube of clay in the middle, what was the shape of the cut surface?

A.

B. 

C.

D.

E.

10. In which diagram would the ball be going up?

A.

B.

C.

D.

E.

11. [illegible] cut a cylinder in half the long ways, what was the shape that he saw on the cut surface?

A.

B.

C.

D.

E.

12. Gene and Scott were experimenting with 2 similar pieces of paper. The first piece of paper they wadded up and the second piece of paper they folded. Then they dropped both pieces of paper out of the classroom window. The first piece of paper landed on the sidewalk first. What reason explains why it fell faster?

A. Both pieces of paper were the same size.

B. Air pushes up more on the folded piece of paper.

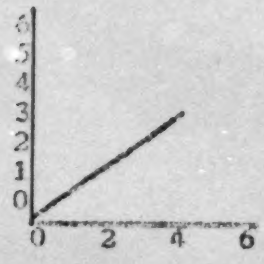
C. The color of the paper was green.

D. Both pieces of paper were dropped at the same time.

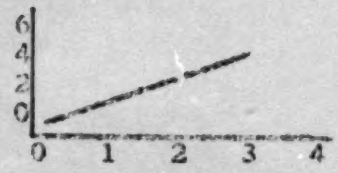
E. One piece of paper weighs more than the other.

13 In testing his rubber band, Joe found that one washer stretched it 2 centimeters, two washers streched it 4 centimeters, and three washers stretched it 6 centimeters. Which graph correctly shows Joe's results?

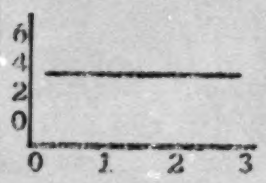
A.



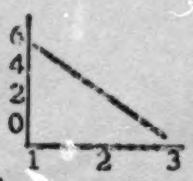
B.



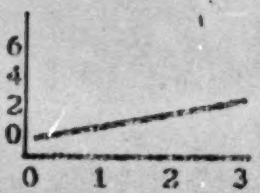
C.



D.



E.



14. Both the rubber band that Joe was using in #13, Bill pulled on it and stretched it to five centimeters. His force was the same as:

A. 2 washers

B. 3 washers

C. Between 2 and 3 washers

D. 5 washers

E. 2 washers

15. At the race track, the line up of cars depends upon their speed. The judges placed the cars in the line based on their speed trials during the week before the races. What information do the judges need in order to decide on the position of the cars?

A. The horsepower of the race car.

B. The distance around the track.

C. The time it took the car to go around the track.

D. The distance around the track and the time it took the car to goaround the track.

E. The safety features of the car.

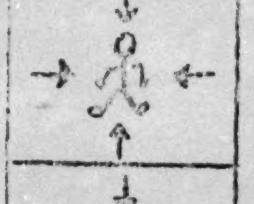
16. In which diagram would the boy be falling down?

A.

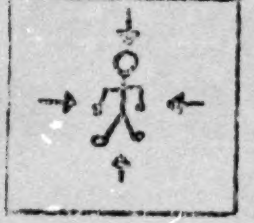
B.

C.

D.



E.



17. Doug and Carol's mother had been watching how long it took them to do their homework. These were her observations:

Day	Homework Time	
	Doug	Carol
1	15 minutes	10 minutes
2	25 minutes	15 minutes
3	20 minutes	15 minutes
4	20 minutes	40 minutes

Based on this information what conclusions should their mother make?

A. The homework time for Carol shows that more often than Doug she takes longer to do her homework.

B. The homework time for Doug shows that more often than Carol he takes longer to do his homework.

C. Doug and Carol like to do their homework.

D. Carol's homework is more difficult than Doug's.

E. The homework time for Carol shows that she is more interested especially in Geography.

18. Doug's mother decided to help him with his homework. She then observed that Doug and Carol spent these times on their homework in the second week:

Day	Homework for second week	
	Doug	Carol
1	15 minutes	10 minutes
2	15 minutes	15 minutes
3	10 minutes	15 minutes
4	10 minutes	40 minutes

Based on the observations of week (see #17) and observations of week 2, what conclusions can Doug's mother make?

A. Carol's homework is easier.

B. Doug has improved his study habits when doing homework.

C. Carol has improved her study habits when doing homework.

D. Both Carol and Doug have improved their study habits in doing their homework.

E. Neither Carol nor Doug have improved their study habits when doing their homework.

19 Shirley was sleeping and thought someone had come into her room. How could Shirley test her inference that someone was actually in her room?

A. She could listen carefully.

B. She could turn on the light.

C. She could open her eyes.

D. She could call for her father.

E. She could do all of these.

20 Bill and Kathy had set up their experiment with corn seeds in the classroom. They were careful to put only soil and corn seeds in the pot, and to water it every fourth day. Two weeks later they found both corn plants and weeds growing in the pot. What inference could they make about how the weeds got into the pot?

A. The wind blew the weed seeds into the pot.

B. There were weed seeds in the soil before the corn was planted.

C. Some corn seeds may have weed seeds on them.

D. The container had weed seeds in it.

E. All of the above inferences may be true.

21. Bill and Kathy decided they wanted to test the inference that the wind had blown weed seeds into the pot. To do this, which experiment should they try?

A. Repeat the first experiment with corn seeds.

B. Try a new experiment in which they used two different containers.

C. Try a new experiment in which they cover one container with clear plastic.

D. Try a new experiment in which they used sand and clay soil.

E. Try a new experiment in which they used peas and corn seeds.

22. In measuring the weight of a block, Gene found that four blocks showed 20 units on a spring scale and that 8 blocks showed 40 units on a spring scale. How much would 6 blocks register on a spring scale?

A. 20 units
B. 25 units
C. 30 units
D. 35 units
E. 40 units

23. With the same type of block and spring scale, what would one block register?

A. 0 units
B. 5 units
C. 10 units
D. 15 units
E. 20 units

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

memo

TO: Science Process Committee members - Mr. Bledsoe, Mrs. Cogar, Miss. Everhart, Mr. Fleury, Mrs. Harkness, Mrs. Howell, Mrs. Peach, and Mrs. Stevens & Mrs. Pat Tate

FROM: Neal Fertitta

DATE: Nov. 4, 1975

COPY TO: Mr. Bloom, Mrs. Jackson, Mr. Roth

SUBJECT: Field Testing Assistance of Science Process Materials

The following days have been selected by Mrs. Jackson, Mr. Roth and myself for me to be full time at Woodside Elementary to provide resource assistance in field testing science process materials in the areas of - (a) interpretation of county committee materials, (b) identifying instructional activities, (c) obtaining and/or constructing instructional materials, (d) planing with you in these areas, (e) working with children, (f) other areas of assistance you may identify.

We will also be assessing the materials and activities.

Mr. Tom Subock will be at the school on many of the same days to work in some of these areas.

JANUARY

Monday	Tuesday	Wednesday	Thursday
	6	7	
12		14	
19		21	
26			29

FEBRUARY

Monday	Tuesday	Wednesday	Thursday	Friday
	3		5	
	10		12	
	17		19	
	24			27

MARCH

Monday	Tuesday	Wednesday	Thursday
			4
	9		
	16		
22			

UNIFIED SCIENCE PROCESS PROJECT

Implementation - Woodside Elementary

January 12, 1976

RE: Planning Session Lois Stevens

for P.L. II P.L.O. 2 (grade 1)

SUMMARY:

1. Based on a review of the pretest results it was decided that students could easily move into the use of the process scheme.

2. In teaching the new science P.L.O., it was decided to teach toward the following Component Skills -

OBSERVING #1

1.02 identifies the sense(s) used in making observations
1.05 begins to use simple tools and instruments for collecting information

CLASSIFYING #2

2.03 independently groups an array of objects by similarities and differences, and gives the reason(s) for the groups

INFERRING #3

3.02 states evidence to support inferences

SPACE/TIME RELATIONSHIPS #7

7.06 records time when an event occurs, with teacher guidance

3. Activities selected -

E.O. 1 - Use activities 1 and 2 in Teacher Guide. Have students bring in objects.

E.O. 2 - Use activities 1,2,and 3 as described in Teacher Guide. Activity 4 can be a project to be developed in the art class.

E.O. 3 - Teach at same time as E.O. 2 and use same materials.

E.O. 4 - Use activity I in Guide. Modify so that students act out the movement of the planets.

UNIFIED SCIENCE PROCESS SCHEME

Classroom Observation Form

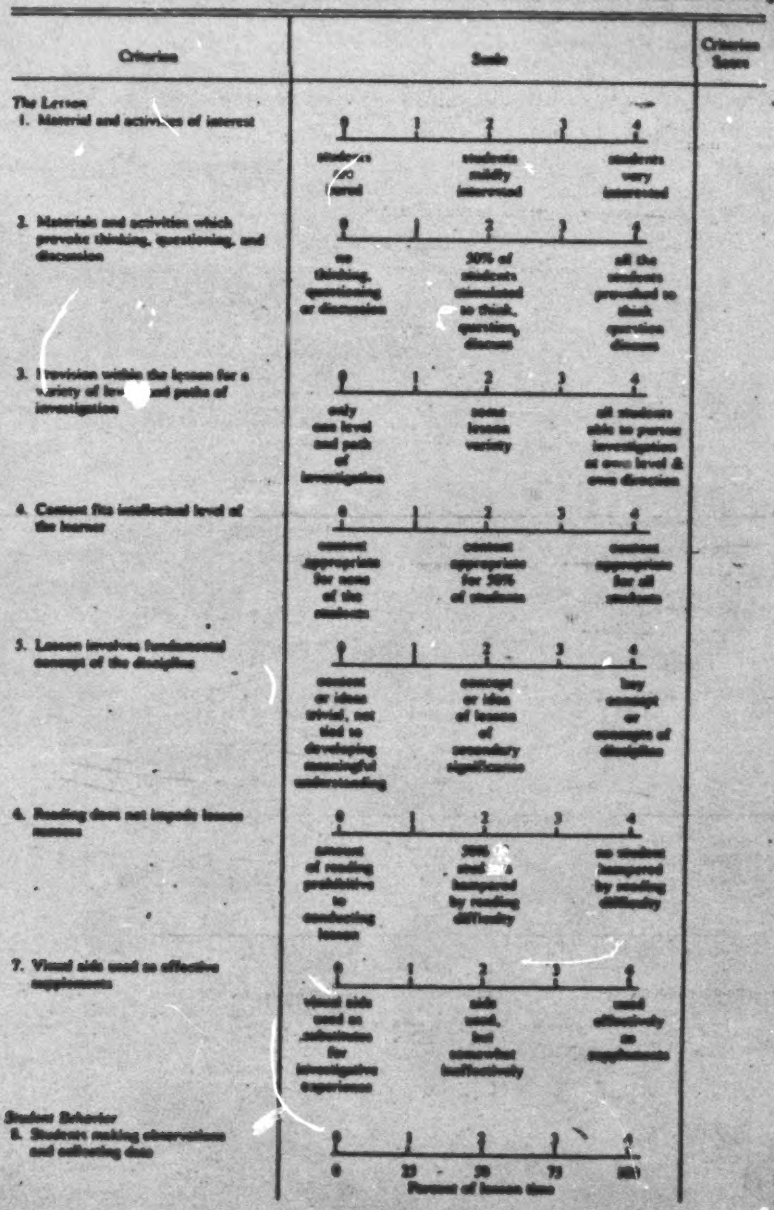
Woodside Elementary

Teacher - _____

_____

Grade - _____

Date - _____


Criterion
Scale
Criterion Score
The Lesson
1. Material and activities of interest
2. Materials and activities which provoke thinking, questioning, and discussion
3. Provision within the lesson for a variety of levels and paths of investigation
4. Content fits intellectual level of the learner
5. Lesson involves fundamental concept of the discipline
6. Reading does not impede lesson success
7. Visual aids used as effective supplements
Student Behavior
8. Students making observations and collecting data

Criterion	Scale	Criterion Score
9. Students formulating and testing hypotheses, models or predictions	0 1 2 3 4 0 25 50 75 100 Percent of lesson time	
10. Students analyzing, interpreting and evaluating data	0 1 2 3 4 0 25 50 75 100 Percent of lesson time	
11. Class conclusions based on evidence	0 1 2 3 4 conclusions based on teacher authority conclusions based on some evidence and some teacher authority all conclusions based on evidence drawn from investigations by students	
Teacher Behavior 12. Is fellow investigator	0 1 2 3 4 No about 50% of time Yes	
13. Acts as a classroom secretary when data need to be organized	0 1 2 3 4 No 50% of the time Yes	
14. Concept introduced *after* direct experiences	0 1 2 3 4 No 50% of the time Yes	
15. Opportunities for extending concept meaning provided	0 1 2 3 4 concept introduced and not referred to again numerous examples are mentioned and discussed additional lessons involve concept to enlarge, refine, and reinforce meaning	
16. Calmly handles classroom interruptions	0 1 2 3 4 No 50% of the time Yes	
17. Appears confident, calm, friendly	0 1 2 3 4 No 50% of the time Yes	
Questioning Techniques 18. Majority of teacher questions are divergent	0 1 2 3 4 No few divergent questions used Yes	

Criterion	Scale	Criterion Score
19. Convergent questions used effectively	0 1 2 3 4 No 50% of the time Yes	
20. Questions are phrased directly and simply	0 1 2 3 4 No 50% of the time Yes	
21. Individuals called upon after questions asked	0 1 2 3 4 No 50% of the time Yes	
22. Allows sufficient time for student response	0 1 2 3 4 No 50% of the time Yes	
23. Accepts student answers and opinions	0 1 2 3 4 No 50% of the time Yes	
24. Responds to questions by providing additional ideas, information, or clues to extend student thinking	0 1 2 3 4 No 50% of the time Yes	
25. Teacher and students enjoyed the lesson	0 1 2 3 4 No one enjoyed the lesson 50% of the students all the students and the teacher	

APPENDIX X

STAFF DEVELOPMENT APPROVAL FORM 101

MSDE Ref. #76-48

Title of Project: Science Process TEaching in the Unified Science Program EDUC 0490-Individual Projects

Coordinator: Dr. James Sacco & Mr. Neil Fertitta **Instructor:** Dr. Homer Schamp

Amount of credit requested: 2

Request submitted to State Department of Education: 12/23/75 Date

Approved by State Department of Education: 1/23/76 Date

- - - -

APPENDIX X (cont)

BOARD OF EDUCATION OF Anne Arundel COUNTY (CITY) 102

TO: The State Superintendent of Schools:

FROM: Eileen M. Oickle, Coordinator of Staff Development, A. A. County Bd. of Education, 2644 Riva Road, Annapolis, Maryland 21401

IN RE: Spring 1976 Workshop

Following is an outline of a proposed inservice program to be offered for professional growth credit:

Coordinator Dr. James Sacco - UMBC Teaching Center
Mr. Neal Fertitta - Science Resource Teacher
(Name) (Position)

Instructor Dr. Homer Schamp - Professor UMBC Education Department
(Name) (Position)

Consultant(s) _____
(Name) (Position)

_____
(Name) (Position)

Beginning Date: January 22, 1976 Closing Date: April 1, 1976

Title of Program: Science Process Teaching in the Unified Science Program
EDUC 0490 - Individual Projects

No. of hours per class session: 3 No. of class sessions 11

Amount of credit requested: 2 PLUS OUTSIDE ASSIGNMENTS

Will you please indicate whether this inservice program meets with your approval for use as professional growth credit.

Approved: Edward J. Anderson Date: 12/23/75
County (City) Superintendent of Schools

- -

Approved for Professional Growth Credit: Fred J. Brown, Jr. Date: 1/23/76
Associate State Superintendent,
Bureau of Educational Programs

Approved for Certification Credit: Howard C. Allison Date: 1/28/76
Assistant State Superintendent
Division of Certification and Accreditation

Prepare and Forward in Quadruplicate to Associate State Superintendent, Bureau of Educational Programs

APPENDIX X

PLAN FOR INSERVICE ACTIVITY

State Specific Objectives

1. To formulate an operational knowledge of the meaning associated with specific science processes.
2. To operationalize the teaching of science processes by developing appropriate activities.
3. To develop skill and technique in teaching science processes.

List Tentative Schedule of Events

Each class session will deal with one or more processes in terms of how they can be presented for learning. The session will be in two parts:
Part 1, presentation of the process(s) theory and practice, and
Part 2, appropriate activities

Briefly Describe Content

Participants will develop skill in teaching and preparing activities matched to specified component skill requirements for successful acquisition of science processes. Seven Areas of science processes will be studied in the course.

Describe Types of Experiences To Be Provided for Participants

Audio-visual presentation
Demonstration Lessons
Inquiry approaches
Small group work sessions
Testing activities in the classroom
Outside research and preparation projects

State Methods of Evaluating Participants' Attainment of the Objectives

The degree of proficiency in identifying appropriate activities for specified component skills for each science process.

The preparation of appropriate process oriented activities.

Prepare and Forward in Quadruplicate to Associate State Superintendent, Bureau of Educational Programs

APPENDIX X
INSERVICE COURSE INSTRUCTOR

Name Dr. Homer Schamp

Academic Background

Degree Ph.D - University of Michigan

Year Granted 1952

Major Physics

Brief Résumé of Professional Experience

credentials on file with State Department

Current Assignment

Research Professor of Education - UMBC

Prepare and Forward in Quadruplicate to Associate State Superintendent,
Bureau of Educational Programs

UNIVERSITY OF MARYLAND BALTIMORE CAMPUS

Off-Campus Credit Courses for Teachers

at

Brooklyn Park Elementary School
and Woodside Elementary School

IMPROVING MOTIVATION THROUGH CURRICULUM PLANNING USING LEARNING HIERARCHIES *

Description

This course is designed to provide teachers with new and effective ways of improving motivation and preparing for accountability. The key to preparing for accountability in the classroom is long range curriculum planning and continuous monitoring of the progress of every child. Learning hierarchies and behavioral objectives are used as a way of specifying the structure of what is to be learned and as a way of letting the student and the teacher know exactly what has been and is to be learned. Teachers will be asked to make immediate applications in their own classrooms. (Limited to 25 participants.)

Credit:	Three (3)
Place:	Brooklyn Park Elementary School
Time:	3:15 - 5:15 p.m.
Date:	February 4 - May 12, 1976
Coordinator:	James Sacco
Instructor:	Marvin Cook, Assoc. Professor of Education, UMBC

* Graduate level credit is available to those participants already enrolled in a graduate program and have the approval of their advisor.

EDUC 0490 - INDIVIDUAL PROJECTS SCIENCE PROCESS TEACHING IN THE UNIFIED SCIENCE PROGRAM

Description

The course will concentrate on activities for children engaged in the Anne Arundel County Public Schools' Unified Science Program. Building on areas already identified as being closely tied to process work, the course will help teachers develop teaching units which promote the learning of process skills. The work will emphasize the blending of elements of the program into different aspects of the curriculum so that the children begin to sense the continuity of their learning.

Credit:	Two (2)
Place:	Woodside Elementary School
Time:	3:00 - 5:00 p.m.
Date:	January 8 - April 1, 1976
Coordinator:	James Sacco and Neil Fertitta
Instructor:	Homer Schamp

STANDARD LESSON SCORE

TEACHER	DATE	SCORE
K	1/20	90 (pre)
	2/5	88
	2/18	90
	3/3	94
	3/16	96 (post)
1	1/20	78 (pre)
	2/3	75
	2/18	80
	3/3	86
	3/16	92 (post)
2	1/20	75 (pre)
	2/3	78
	2/24	74
	3/3	82
	3/16	85 (post)
3	1/20	75 (pre)
	2/3	80
	2/18	76
	3/3	80
	3/16	86 (post)
4	1/15	80 (pre)
	2/5	85
	2/17	85
	3/2	90
	3/17	88 (post)
5	1/15	39 (pre)
	2/5	46
	2/17	55
	3/2	45
	3/17	61 (post)
6	1/15	80 (pre)
	2/5	85
	2/17	94
	3/2	92
	3/17	90 (post)

UNIFIED SCIENCE PROCESS PROJECT

Evaluation

Woodside Elementary - Implementation **April 2, 1976**

The county Science Process Scheme committee would appreciate your reaction to the following questions.

1. Do you feel that the Component Skills will be helpful to you in infusing process teaching into the science program?

... They help break down the steps of a skill. If a student is lacking in certain components, the teacher can help that student build....yes...yes...yes...Very MUCH .... yes...yes...Yes, very helpful...yes

2. Is the sequence of process Component Skills specific enough but not rigid?

...Yes, One knows that he/she can move anywhere depending upon the abilities of the student....Yes, a good balance. I have used the component skills as a base- but felt free to add or subtract according as things developed in the class...yes...yes...yes...yes...yes....yes...yes

3. Do you feel that the suggested activity(ies) clearly relate to both the process Component Skills and the science content?

...Yes...Yes...Yes...Yes...Yes...In most cases...Yes... Yes...Yes.

4. Are the suggested activities realistic?

...Yes...Yes...Yes...Yes...Yes...Yes...Yes...Yes...Yes.

5. Does the sequence of process Component Skills assist you in identifying activities that relate to both processes and content?

... Yes...Yes...Yes...Yes...Yes...Yes...Yes...Yes...Yes

- - - continued - -

6. Do you feel you are able to provide students with a better balanced program of process and content learning by using these materials?

...Yes, I do. I needed a structured program... It is helpful. Hopefully schools will share ideas and activities....Yes...Yes...Yes...Very much so...Yes ...Yes...Yes

7. Do you feel your students are growing in their ability to use science processes and process oriented thinking?

...Yes...Somewhat...In most cases...Yes... Gradually... They seem to be doing well...Yes...Yes...Yes.

8. Is the format of the 2 supplement books appropriate. If not, what suggestion would you make?

... Yes...Seems easy to use...Ithink so...Yes...Yes... Yes...Yes...Yes...Yes.

9. Do you have other comments?

... I am enjoying the science program in second grade, even though I am just feeling my way. It is goog to have a real guide to a structured science program... We have found many of the activities interesting and valuable...The materials are helpful...No...Not at this time...I understand how to teach the science program better.

THANK YOU

Pretest - Posttest

MEAN SCORES

Primary Level

Kindergarden

	Obser.	S/T Rela.	Class.	Meas.	Total Mean
Pretest	7.6	10.2	3.0	4.8	25.6
Posttest	8.4	11.0	3.0	5.0	27.4

Grade 1

	Obser.	S/T Rela.	Class.	Meas.	Total Mean
Pretest	7.1	8.6	2.2	1.9	11.2
Posttest	8.9	10.8	3.0	4.7	27.5

Grade 2

	Obser.	S/T Rela.	Class.	Meas.	Total Mean
Pretest	7.2	9.8	1.5	1.0	19.5
Posttest	8.9	11.0	2.8	3.5	26.2

Grade 3

	Obser.	S/T Rela.	Class.	Meas.	Total Mean
Pretest	5.7	9.7	1.8	0.1	17.2
Posttest	8.4	10.5	2.6	3.6	25.1

Process Code: Obser. ------ observation
S/T Rela. --- space/time relationship
Class. ------ classification
Meas. ------- measuring

Pretest - Posttest

MEAN SCORES

Intermediate Level

Grade 4

	Pred.	ID	S/T	Infer.	Meas.	Obser.	Total Mean
Pretest	1.3	1.1	2.1	1.3	1.1	0.4	7.9
Posttest	2.3	1.8	3.4	2.3	1.5	1.0	12.3

Grade 5

	Pred.	ID	S/T	Infer.	Meas.	Obser.	Total Mean
Pretest	2.6	1.7	3.1	2.3	1.4	0.6	11.4
Posttest	2.7	2.2	3.4	3.0	2.0	1.0	14.1

Grade 6

	Pred.	ID	S/T	Infer.	Meas.	Obser.	Total Mean
Pretest	2.5	1.8	3.1	2.4	1.6	0.4	11.8
Posttest	2.7	2.3	3.7	2.6	2.2	1.0	14.4

Process Code:

Pred. ------- predicting
ID ---------- interpreting data
S/T --------- space/time relationship
Infer. ------ inferring
Meas. ------- measuring
Obser. ------ observing

Pretest - Posttest

PERCENTAGE (%) SCORES

Kindergarden		Grade 1		Grade 2		Grade 3	
Pre.	Post.	Pre.	Post.	Pre.	Post.	Pre.	Post.
82.1	96.4	89.2	100	75	96.4	64.3	92.9
82.1	100	75	100	53.6	85.7	67.9	96.4
92.8	100	67.8	100	75	89.3	64.3	89.3
92.8	96.4	67.8	96.4	71.4	92.9	50	75
82.1	100	82.1	100	64.3	92.9	71.4	96.4
96.4	100	50	100	64.3	96.4	75	92.9
96.4	96.4	64.3	100	75	96.4	75	96.4
96.4	96.4	60.7	100	67.9	92.9	53.6	85.7
96.4	96.4	75	100	67.9	89.3	64.3	92.9
96.4	96.4	64.3	100	53.6	85.7	42.6	92.9
		82.1	100	71.4	92.9	64.3	100
		67.8	100	53.6	92.9	71.4	92.9
		67.8	100	78.6	100	53.6	78.6
		75	96.4	78.6	92.9	64.3	92.9
		53.6	92.9	71.4	85.7	64.3	92.9
		75	96.4	67.9	96.4	60.7	89.3
		75	89.3	67.9	96.4	28.6	64.3
		67.8	92.9	75	96.4	64.3	92.9
		85.7	100	78.6	92.9	60.7	89.3
		75	92.9	71.4	96.4	67.9	89.3
		67.8	100	64.3	96.4		
		75	100	75	92.9		
		71.4	100	64.3	92.9		
				75	96.4		
				75	96.4		
				75	96.4		

Pretest - Posttest

PERCENTAGE (%) SCORES

Grade 4		Grade 5		Grade 6	
Pre.	Post.	Pre.	Post.	Pre.	Post.
18.2	50	50	68.2	40.9	68.2
31.8	54.5	45.5	45.5	40.9	54.5
63.6	63.6	68.2	81.8	77.3	81.8
54.5	63.6	40.9	59	45.5	54.5
4.5	40.9	59.1	81.8	45.5	63.6
13.6	36.4	31.8	54.5	63.6	72.7
45.5	50	45.5	72.7	45.5	54.5
22.7	63.6	77.3	81.8	40.9	68.2
31.8	72.7	36.4	45.5	50	59
18.2	40.9	72.7	86.4	31.8	54.5
40.9	50	22.7	40.9	68.2	72.7
18.2	36.4	63.6	72.7	50	77.3
22.7	59.1	50	63.6	59	63.6
50	77.3	63.6	68.2	45.5	59
27.3	45.5	40.9	50	59	59
36.4	68.2	27.3	50	63.6	81.8
54.5	59	50	77.3	59	63.6
22.7	27.3	54.5	54.5	68.2	81.8
45.5	77.3	68.2	68.2	54.5	63.6
50	68.2	59.1	63.6	77.3	77.3
40.9	45.5	40.9	63.6	36.4	40.9
59	72.7	63.6	72.7		
54.5	68.2	50	59.1		
		36.4	54.5		
		68.2	68.2		
		63.6	63.6		

GROWTH IN SCIENCE PROCESS SKILLS

GRADE	#Quest. in range	#Stud.	%by Grade	%Stud.
K	0	10	0	
1	17	23	73.9	
2	21	26	80.8	
3	18	20	90	54.7%
4	12	24	50	
5	9	26	34.6	show
6	5	21	23.8	20% gain
K	2	same	20	
1	22		95.6	
2	25		96.2	
3	20		100	66.7%
4	14		58.3	
5	11		42.3	show
6	6		28.6	15% gain
K	3	same	30	
1	23		100	
2	26		100	
3	20		100	76 %
4	18		75	
5	14		53.8	show
6	10		47.6	10% gain
K	4	same	40	
1	23		100	
2	26		100	
3	20		100	86 %
4	18		75	
5	20		76.9	show
6	18		85.7	3% Gain

ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

2644 Riva Road
Annapolis, Maryland 21401
Telephone: 301-224-0113

April 13, 1976

Mr. Neal Fertitta
Science Resource
Area I Office
First Avenue and "A" Street
Glen Burnie, Maryland 21061

Dear Mr. Fertitta:

It appears that the initial production workshops and classroom testing of the Unified Science Process Project have been successful. The positive results on the pretest/postest and the attitude of teachers involved are indications of the potential of the Process Scheme as related to the effectiveness of the program.

Completion of the process spiral on our program model will be a great help to teachers of Unified Science. To date, the product portion of the program has actually supported the process aspect in a fairly random fashion. The Process Scheme will provide a more meaningful total program for planning and instruction.

We will move ahead at the earliest possible date to provide additional inservice activity to disseminate and implement the process materials.

Sincerely,

Harold Bloom

Harold Bloom
Coordinator of Science
Anne Arundel County Public Schools

HB/lmb

BOARD OF EDUCATION: G. George Asaki, president, F. Carroll Smith, vice president, Dr. Dolores C. Hunt, Mrs. Maureen Lamb, Col. Raymond C. Smith, Charles G. Truffer, Mrs. S. Edwin Zimmerman, J. Jeffrey Robinson (student member)

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